Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

SEPTEMBER ★ 1951

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

Page 109—Journal Section of The American Society of Heating and Ventilating Engineers

Official photograph, U. S. Navy

Navy Has Pressing Air Conditioning Problems ..... *see page 69*

How to Space Pipe Supports 90

Radiation Screens for Hot Spots . 96

Electronic Combustion Safeguards 77

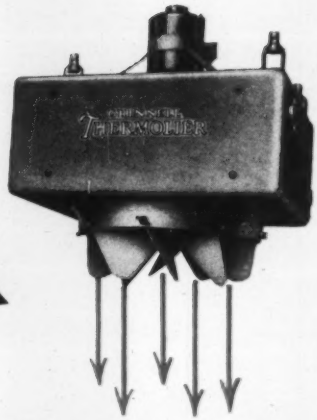
Contractor's Movie Shows Piping Job 73

MANY OTHER PRACTICAL IDEAS—SEE COMPLETE CONTENTS, PAGE 5

DOWNRIGHT

better performance

Vertical Delivery
THERMOLIER
Unit Heaters . . .



RIGHT DOWN

where maximum heat is desired...

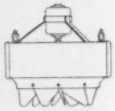
in warehouses, plants and other hard-to-heat buildings

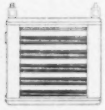
HEATING COMFORT AND ECONOMY. Heat is forced down to the working level . . . not banked uselessly at the ceiling level. Thermoliers provide quick heating from a cold start. Desired room temperatures are easily maintained within a close range.

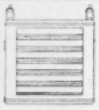
ADAPTABILITY TO EQUIPMENT AND FLOOR LAYOUT. The units and the simple piping are overhead where they do not interfere with arrangement of operating machinery or equipment and do not take up valuable floor or wall space. Units are easily relocated at any time to meet changes in plant layout or heating requirements.

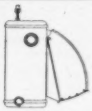
LOW FIRST COST. Thermoliers are so efficient and so compact that their heating capacity is often equivalent to the capacity of cast iron radiation or pipe coils of twice the cost.

4 MODELS . . . . . 18 SIZES


Vertical Delivery


Horizontal Delivery


Textile Model


Velocity Nozzle

A thermostatic trap, the simplest and least expensive of all traps, is practical because of Thermolier's exclusive cooling leg.

Maximum capacity assured, annoying destructive water hammer eliminated — by built-in pitch of tubes and internal cooling leg which assure continuous drainage of condensate.

Damaging strains caused by expansion and contraction eliminated by "U" type expansion tubes.

Safety and durability assured with leak-proof tube-to-header construction.

Five other important construction features. Write for Thermolier Catalog.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company Inc., Providence 1, Rhode Island • Sales Offices and Warehouses in Principal Cities

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco humidification and cooling systems

Tools of Air Conditioning

JOB IDEAS BY **usAIRco**

UNIT AIR CONDITIONER: for Industrial and Commercial Application

Units for year-round air conditioning or for any combination of air conditioning functions. Basic unit consists of fan section with cooling and/or heating coils. Filter sections, mixing chambers and dampers, humidifiers, face and by-pass dampers may be added as application requires. Built in ceiling and floor models in 9 standard sizes from 1000 CFM to 12,000 CFM. These packaged units provide efficient, low cost air conditioning for stores, restaurants, offices, laboratories, industrial plants.

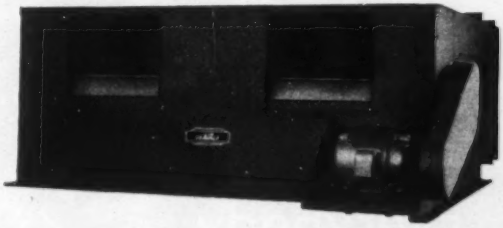
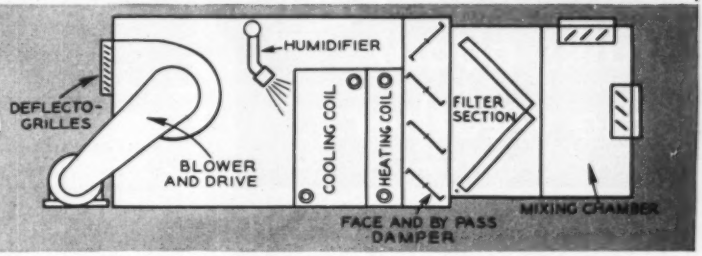
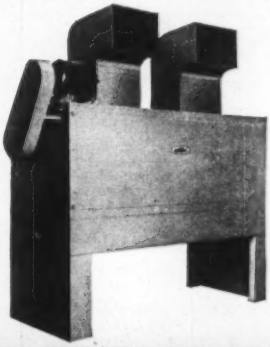


Diagram shows unit equipped to do a year-round air conditioning job of cooling, heating, filtering, ventilating, and humidity control.





BLOWER TYPE UNIT HEATER: for Heating Large Volumes of Air

Designed for wide application in factories, warehouses, garages. Can be used in any one of four positions: for floor, ceiling, inverted or wall mounting. Units built in sections for easy handling, installation, maintenance. Available with standard steam or steam distributing tube coils in any one of five capacity series. Standard unit consists of blower section, coil section, and accessories as required including filters, mixing chambers and face and by-pass dampers. Built in eight sizes from 37,500 Btu to 1,995,000 Btu per hour.

usAIRco
Everything In Air Conditioning

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3300 Como Avenue S.E., Minneapolis 14, Minn.

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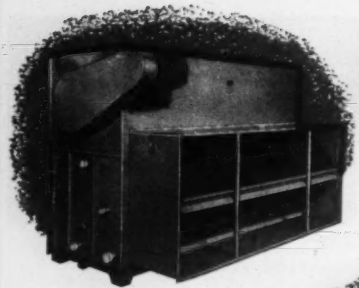
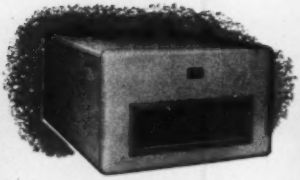


Air Handling Unit — Horizontal and Vertical units available in 8 case sizes with ratings of from 5 to 60 tons.

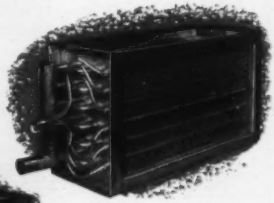


Comfort Conditioner — 2 case sizes with 900 and 1800 CFM and ratings of 3 to 8 tons.

Evaporative Condenser — 5 to 75 ton capacities built in sections to go through standard doors.

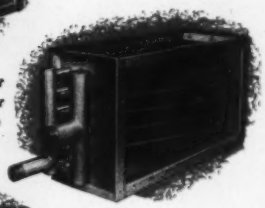
"Everybody talks about the weather..."

"but nobody does anything about it." Mark Twain (who lived a short distance from the present Bush plant) said that . . . and he was right. And he is still *half* right. Everybody *still* talks about the weather . . . more than ever before. But today something *is* being done about it. This determines *what* they say . . . and, most important, what they *buy*. Bush air conditioning and refrigeration equipment is designed to make customers and employees comfortable . . . and, because comfortable customers buy more and comfortable employees work harder, buyers of Bush equipment are more comfortable, too. Get acquainted with the Bush Representative in your territory and experience for yourself the comfortable feeling which comes with Bush service, engineering and dependability.



D X Coil — 6 standard heights and 17 lengths offer a wide variety of sizes for any direct expansion application.

Water Coil — For heating or cooling. Correctly circuited for minimum water pressure drop



Steam Coil — Available as standard or non-freeze. O-Gee curve allows free expansion of tubes. Sizes to match D X Coils.

Cooling Tower—Capacity ratings of 3 to 75 tons. Induced draft type permits locating anywhere inside or outside of building.

Buy the Best-and the Best is

BUSH

HEAT TRANSFER PRODUCTS

Bush Manufacturing Co.

WEST HARTFORD • CONNECTICUT

Heating Piping & Air Conditioning

Vol. 23, No. 9

(with which is merged the Aerologist)

DESIGN, INSTALLATION, OPERATION AND MAINTENANCE IN INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND PUBLIC BUILDINGS

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SEPTEMBER 1951

Feature Articles

Film Produced by Contractor Shows Power Piping Installation 73
Movie shows details

Electronic Safeguards for Oil Burners 77
Kalman Steiner and Wilmer G. Carter

Navy Has Pressing Air Conditioning Problems 80
Captain T. L. Willmon, MC, USN

Three Air Conditioning Systems To Serve Chrysler Building East 84
Design described

District Heating Group Studies Piping and Heating Problems 86
John F. Collins, Jr.

Kansas City—A Quick Mop-Up 89
Flood damage

How to Space Supports for Large Diameter Thin Wall Pipe 90
Theodore E. Bridge

Radiation Screens Improve Work Conditions in "Hot Spots" 96
George F. Haines, Jr.

Water Quality Control for Air Conditioning and Refrigeration 98
Ralph M. Westcott

Ingenuity Solves Piping Problem 102
J. A. Kelleher

Special Heating and Cooling Systems 105
How they serve mobile Army mapping units

Construction Goes Under CMP 206
Beginning October 1

Regular Departments

The Editor's Pages 65
News and notes

"Open for Discussion" 69
Comment and criticism

The Law and Your Profits 103
William Hurd Hillyer

Sam Lewis' Page 104
A popular feature

Data Sheet — "Tips" on Valve Piping 106
Do's and don'ts

Question of the Month 107
Practical help on problems

Equipment Developments 211
News of products

Who's What 227
Names in the news

New Books and Reports 234
For reference and use

Meetings and Conventions 240
The industry's calendar

Recent Trade Literature 246
Available on request

Index to Advertisers 264
In this issue

ASHVE Journal Section

Heat Pump Application to a Newspaper Plant 109
J. Donald Kroeker, John H. Bonebrake and James A. Melvin

Pressure Losses of Take-Offs for Extended-Plenum Duct Systems 117
J. W. Holl, S. F. Gilman, R. J. Martin and S. Konzo

Aluminum Ceiling Panels for Heating and Cooling 125
E. S. Howarth, S. C. Huddleston and R. M. Koch

A Challenging Field 134
I. W. Cotton

Discussions 135
On papers presented at Semi-Annual Meeting

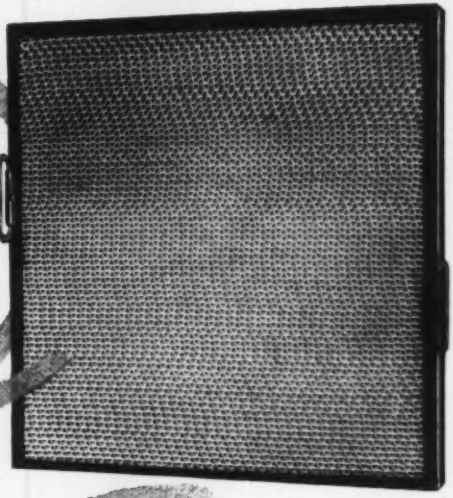
Summary of Chapter Meetings 140

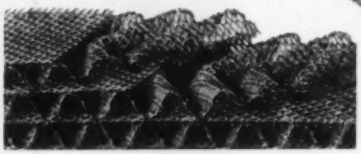
Candidates for Membership 141

Officers, Council and Committees 143

16 gauge filter and holding frames assure well-aligned, rigid filter banks. Interlocking holding frames are easy to install and the rugged construction prevents distortion. Felt liners effectively prevent air by-pass.

Reinforcing rods drilled through the media insure rigidity and add to service life.





Herringbone-crimp media design assures dependable higher performance, larger dirt holding capacity, lower pressure loss, easier cleanability, reduced maintenance costs. Media is packed firmly and evenly in the frame resulting in even density throughout the filter and assuring uniform high efficiency over the entire filter area.

Here's why...

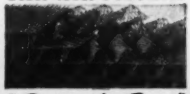
FAR-AIR* FILTERS

are unequalled in Quality, Construction and Performance

You can be sure of a high performance air cleaning job when you specify Far-Air Filters. Precision engineering plus quality construction to rigid specifications assure *uniform* performance. Available in a wide range of types and sizes for dirt, lint, grease, entrained water, paint, ink, and many other air filtering applications. Contact your local representative or write direct to Farr Company, P.O. Box 10187, Airport Station, Los Angeles 45, California.

*Trade Mark Reg.

FAR-AIR FILTERS



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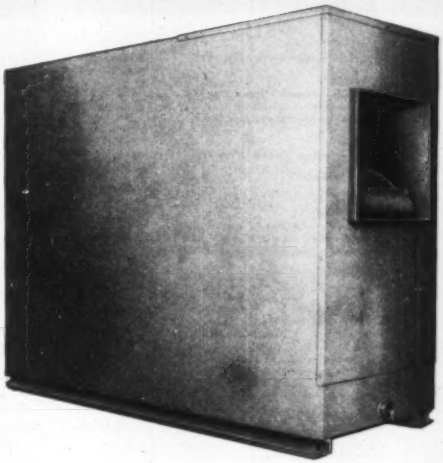
FOR INDOOR OR OUTDOOR COOLING!



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- ✓ Self cleaning, gravity-type distribution.
- ✓ Totally enclosed motor with belt tension adjustment.
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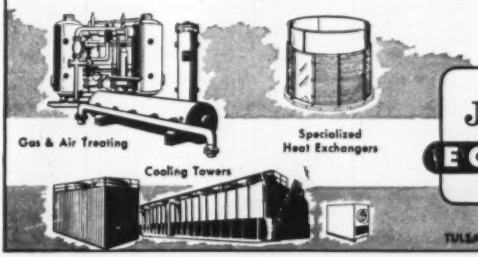

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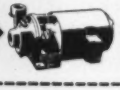

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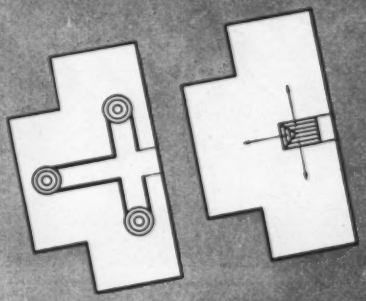
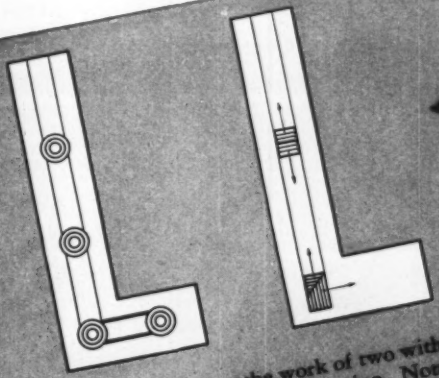
Without Cutting Efficiency

SHORTER DUCT RUNS



Substantial savings in metal and labor are yours due to the shorter duct runs with Agitair tailor-made diffusers.

FEWER OUTLETS



One diffuser does the work of two with no sacrifice in air distribution. Note the savings.

Now you can conserve critical materials and cut costs without cutting efficiency. How? By specifying AGITAIR Type R. Here's the only diffuser that may be assembled in a variety of patterns to provide blows in one-two-three and four directions with discharge orifices proportional to the area being served. Result: 100% air distribution in any shape area, from any location. What savings in metal and money! Get the facts and see for yourself.

Write for Complete Data

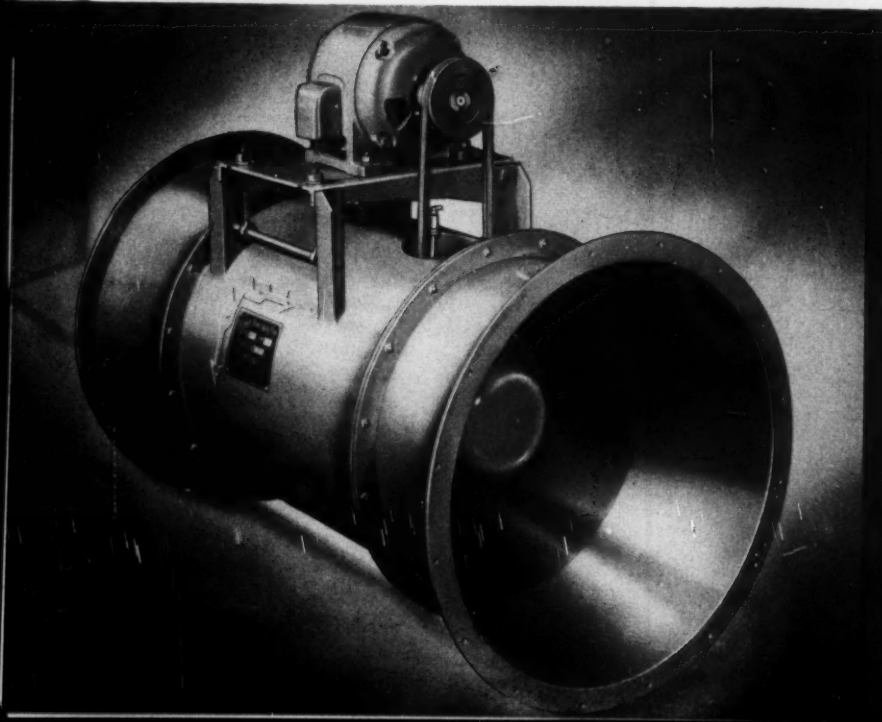
AIR DEVICES Inc.

17 East 42nd Street New York 17, N. Y.

Air Diffusers • Air Filters • Exhausters

Efficient Exhaust and NO SPACE WASTED

"Buffalo" VANEAXIALS MOUNTED IN VERTICAL EXHAUSTS



Yours!

This helpful Bulletin No. 3533-C describes "Buffalo" Axial Flow Fans and their uses. Write for your copy!

ROOF INSTALLATION OF PAPER COMPANY POINTS WAY TO SAVINGS IN MANY INDUSTRIES

Steam is removed continuously in the view above, as some of the ten 36″ "Buffalo" Type "B" Vaneaxial Fans mounted in roof exhausts of West Virginia Pulp and Paper Co., Mechanicville, N.Y., are shown in operation.

Note how the fans fit in like a section of pipe. Their light weight obviates heavy, expensive mountings, and the fans waste no space. The steam comes from hoods from Nos. 5 and 6 paper machines — and passes straight through the pipes and fans with absolute minimum resistance. (In the view of the "Buffalo" Axial Flow Fan at left, note how motor is entirely removed from air stream.)

Whenever YOU need fans for mounting in straight duct runs, you'll save money with "Buffalo" Vaneaxials!

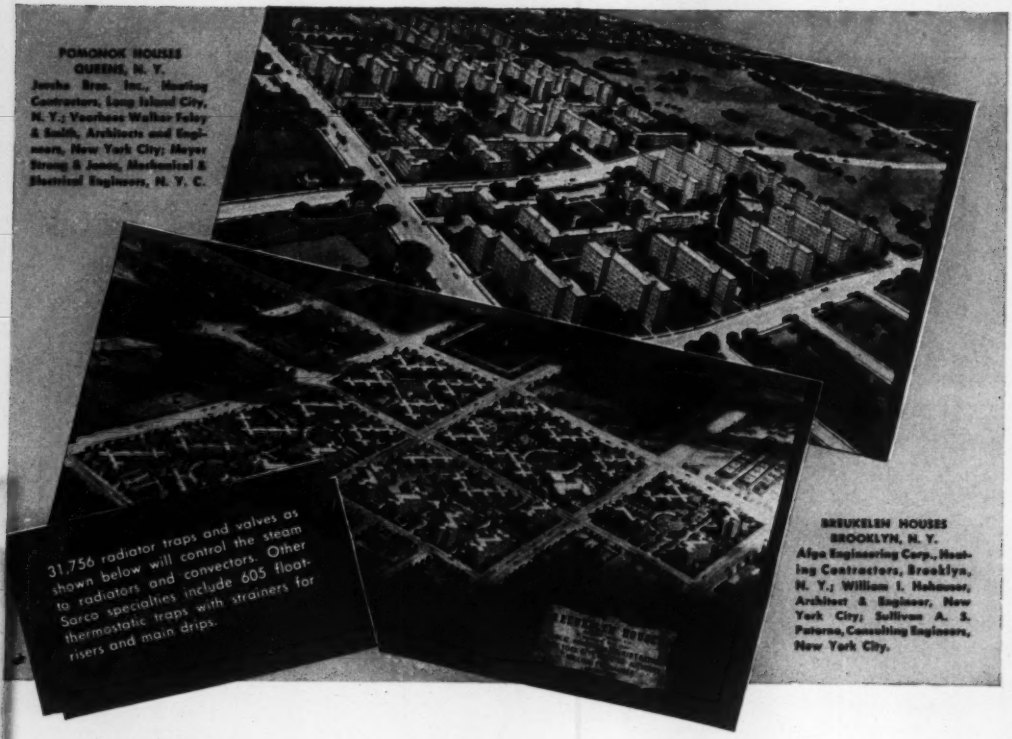
"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

171 Mortimer St. BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont., Branch Offices in all Principal Cities

VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING


POMONOK HOUSES
QUEENS, N. Y.
Jacobs Bros., Inc., Heating Contractors, Long Island City, N. Y.; Voorhees Walker Foley & Smith, Architects and Engineers, New York City; Meyer Strong & Jones, Mechanical & Electrical Engineers, N. Y. C.
31,756 radiator traps and valves as shown below will control the steam to radiators and convectors. Other Sarco specialties include 605 float-thermostatic traps with strainers for risers and main drips.
BREUKELEN HOUSES
BROOKLYN, N. Y.
Alga Engineering Corp., Heating Contractors, Brooklyn, N. Y.; William I. Hohauser, Architect & Engineer, New York City; Sullivan A. S. Paterno, Consulting Engineers, New York City.

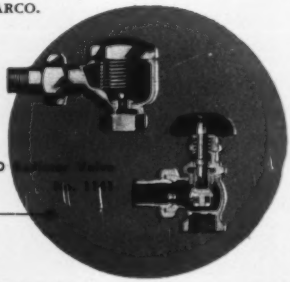
SARCO heating specialties to be used in

3 NEW YORK CITY HOUSING PROJECTS

Seventy-two apartment buildings to house 4,074 families are being equipped with SARCO HEATING SPECIALTIES to insure trouble-free operation.

Two of the three projects are illustrated above. The third is James A. Bland Houses, Flushing, for which the architects are Chapman, Evans and Delehanty of N. Y. C. Syska and Hennessy, Inc. of N. Y. C. are the consulting engineers. H. Sand & Company, Inc., also of N. Y. C., are the heating and ventilating contractors.

For dependable, efficient service over the years, specify SARCO. Write for new Catalog 202, on the complete line.



SARCO Radiator Trap
Type H

SARCO

SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N.Y.

SARCO CANADA LTD., TORONTO 5, ONTARIO

REPRESENTED IN PRINCIPAL CITIES

340

Century

Serves the Electric Motor User in Two Important Ways:

1. Century motors are designed and constructed for a long, dependable operating life.

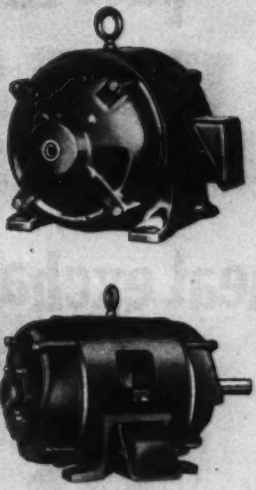
2. Just as important—they are skillfully selected to match the operating characteristics of the many kinds of equipment they drive.

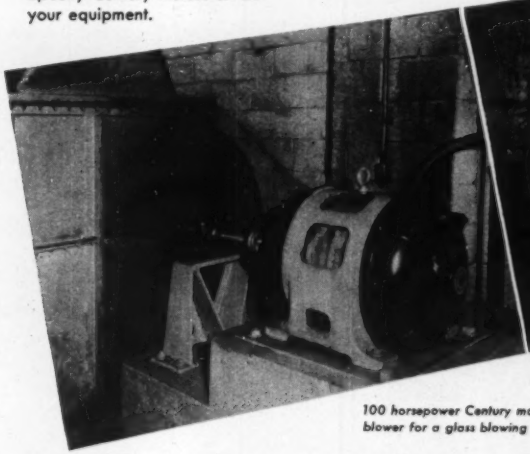
IN CENTURY'S wide range of types and sizes (up to 400 H.P.) there are available: 4 standard classes of starting torque characteristics—6 methods of speed control—constant and short time ratings—4 basic classes of frame protection against atmospheric hazards—a dozen methods of mounting the motor to the equipment—plus many special specifications to meet the requirements of the BIG NAME equipment manufacturers who use Century motors as a component part of their equipment.

Teamwork with equipment producers gives you skillfully selected motors from Century's wide range of types and sizes . . . properly applied to match the performance characteristics of the machines they drive.

Both a properly designed and constructed motor, plus skillful application, are required to give you top performance and long life on the new ultra-modern production equipment.

Specify Century motors on all your equipment.





100 horsepower Century motor drives a blower for a glass blowing machine.

150 horsepower Century motor driving a turbo compressor for a foundry blast furnace.

Century SERVICE Is Near Any CENTURY Motor Driven Equipment

Prompt Service is offered by CENTURY'S National Network of more than 200 Authorized Service Stations, supervised by 28 Century Sales offices.

1. Facilities for immediate exchange of most CENTURY standard ratings of standard construction are available at CENTURY Authorized Service Stations.
2. CENTURY Authorized Service Stations are qualified and equipped to service and repair any piece of CENTURY apparatus.
3. Genuine CENTURY renewal parts are available at CENTURY Service Stations, CENTURY Parts Distributors and at the factory in St. Louis.

Century Electric Company is celebrating its 50th year in the electrical industry

CENTURY ELECTRIC CO.

1806 Pine St. • St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

Century C MOTORS

puts the HEAT on heat exchangers

By changing to Yarway Impulse Steam Traps, an oil refinery reports much hotter steam in their heat exchangers **—plus two other important extras:**

(1) They were able to operate the plant with 6 boilers instead of the 8 formerly required.

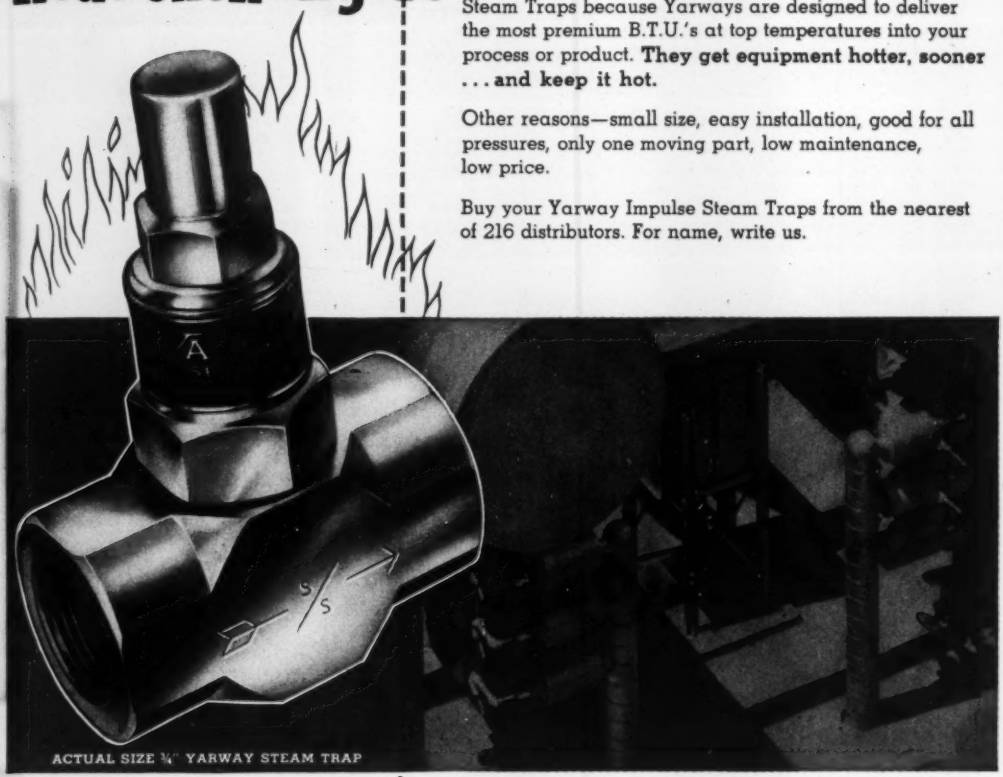
(2) Three men formerly required to service old-type traps can now be used for productive work.

Significant sidelight—these Yarway traps are operating under severe conditions, many outdoors with temperatures often below zero.

Plant after plant is standardizing on Yarway Impulse Steam Traps because Yarways are designed to deliver the most premium B.T.U.'s at top temperatures into your process or product. **They get equipment hotter, sooner . . . and keep it hot.**

Other reasons—small size, easy installation, good for all pressures, only one moving part, low maintenance, low price.

Buy your Yarway Impulse Steam Traps from the nearest of 216 distributors. For name, write us.

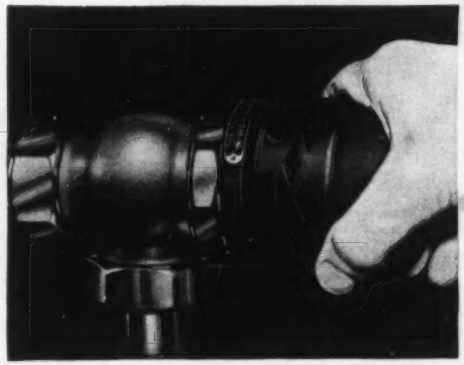


ACTUAL SIZE ¾" YARWAY STEAM TRAP

YARNALL-WARING COMPANY
107 Mermaid Ave., Philadelphia 18, Pa.

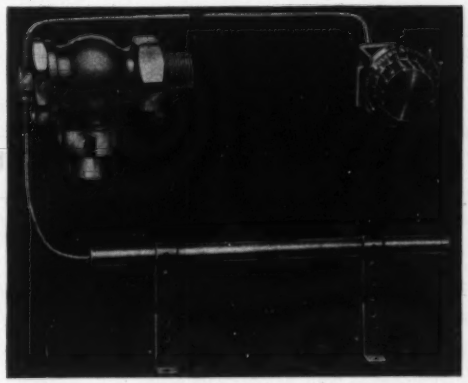
FREE OFFER. Don't take our word for it. Test Yarway's advantages in your own plant, without cost or obligation. Drop us a card or letter—a trial trap will be delivered promptly.

YARWAY the steam trap
designed with more production in mind



Illustrated—two basic types of Sylphon automatic radiator valves. Upper, for exposed radiators. Lower, for enclosed radiators. Both available in angle and globe bodies.

THEY LOWER THE COST OF LIVING *in comfort!*



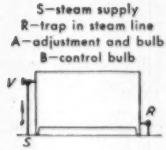
SYLPHON AUTOMATIC RADIATOR VALVES do a *triple* savings job when it comes to keeping rooms comfortable. First, they assure positive, uniform temperature control at *all* times—in one room, an office or entire plant. They eliminate the discomfort of too much or too little heat. Result—fuel is saved and employee efficiency increases.

Second big saving—they substantially reduce heating costs for building owners and operators. Studies show that during 95 per cent of the average winter season, more heat is generated than needed for health and comfort.

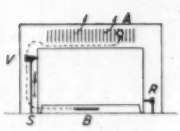
And third—Sylphon Automatic Radiator Valves cost less than any other automatic controlling system available. They're installed easily and quickly on your present radiators. Simple in construction, self-powered, packless—self-contained and fully modulating. They more than pay for themselves—many times—in fuel savings alone.

Install them now. Your savings begin the minute they start working for you. For complete information, send for Bulletin RH-80.

S—steam supply
R—trap in steam line
A—adjustment and bulb
B—control bulb



No. 885 on exposed radiator



No. 895 on concealed radiator

"Everything's under Control"

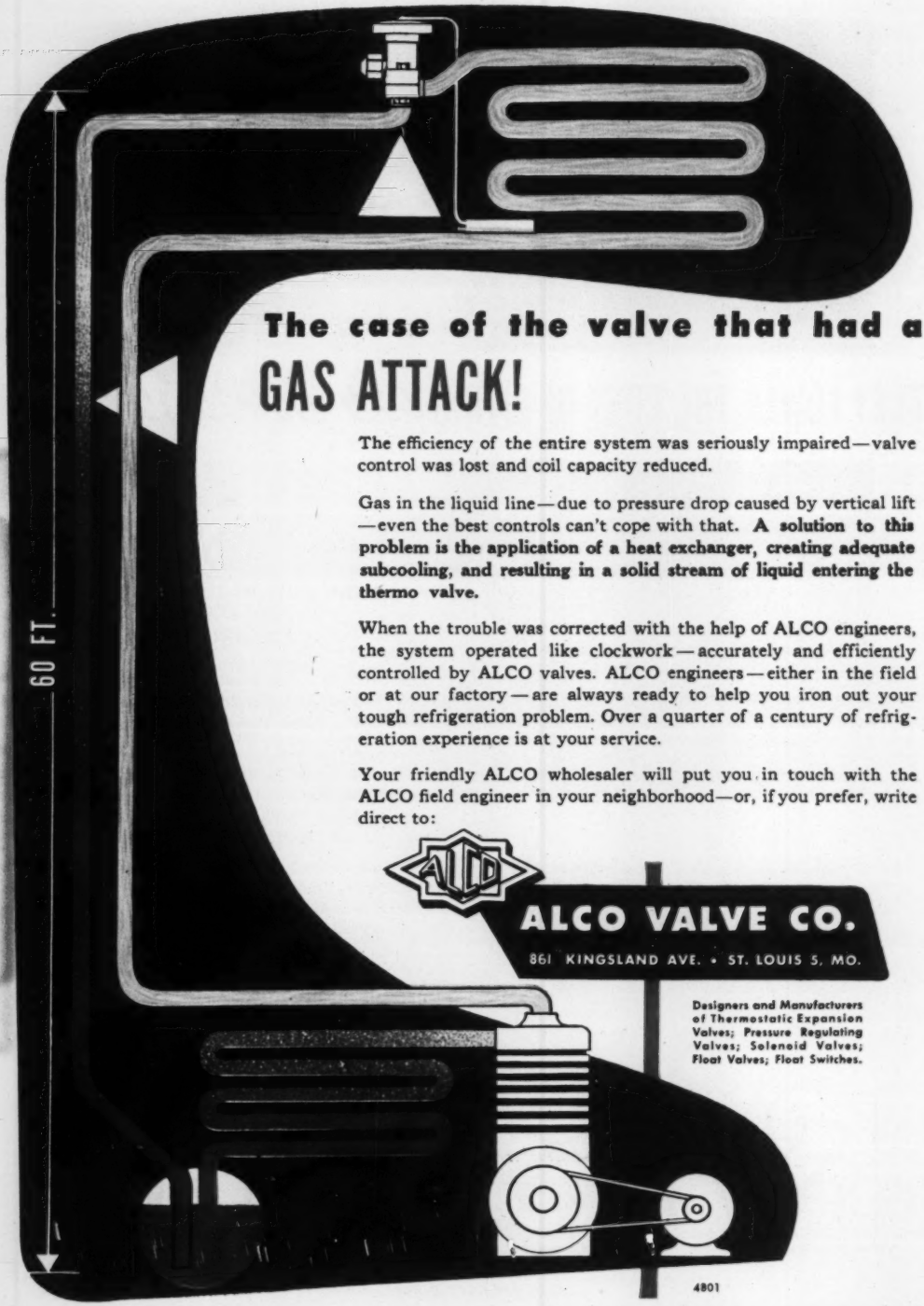
Temperature Controls • Bellows Devices • Bellows Assemblies

FULTON SYLPHON DIVISION

FIRST WITH BELLOWS

ROBERTSHAW-FULTON CONTROLS CO., KNOXVILLE 4, TENN.

Canadian Representatives, Darling Brothers, Montreal



The case of the valve that had a

GAS ATTACK!

The efficiency of the entire system was seriously impaired—valve control was lost and coil capacity reduced.

Gas in the liquid line—due to pressure drop caused by vertical lift—even the best controls can't cope with that. **A solution to this problem is the application of a heat exchanger, creating adequate subcooling, and resulting in a solid stream of liquid entering the thermo valve.**

When the trouble was corrected with the help of ALCO engineers, the system operated like clockwork—accurately and efficiently controlled by ALCO valves. ALCO engineers—either in the field or at our factory—are always ready to help you iron out your tough refrigeration problem. Over a quarter of a century of refrigeration experience is at your service.

Your friendly ALCO wholesaler will put you in touch with the ALCO field engineer in your neighborhood—or, if you prefer, write direct to:

ALCO VALVE CO.

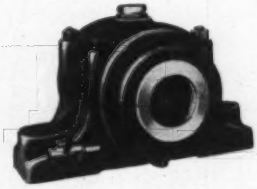
861 KINGSLAND AVE. • ST. LOUIS 5, MO.

Designers and Manufacturers of Thermostatic Expansion Valves; Pressure Regulating Valves; Solenoid Valves; Float Valves; Float Switches.

4801

QUIET DODGE BEARINGS

THE MOST COMPLETE LINE FOR FAN AND BLOWER SERVICE



SLEEVOIL PILLOW BLOCK

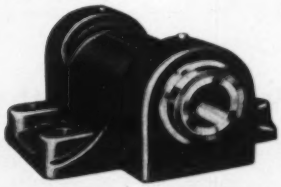
A precision-built, ring-oiling babbitted bearing, self aligning and exceptionally quiet in operation. Special seals prevent oil leakage and keep dirt out of the bearing.

WATER-COOLED SLEEVOIL

Specially designed for applications where elevated temperatures are encountered. Dodge Sleevoil bearings combine quietness with exceptional load carrying capacity; are available in shaft sizes from 1-11/16" to 8".

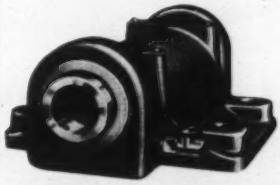
DODGE BRONZOIL

Capillary bronze bushing has capacity of one-third its volume in oil. Reservoir with close fitting wick around bushing provides ample lubrication. Oil resistant grommets available for noise isolation. Sizes 1/2" to 1-1/4".



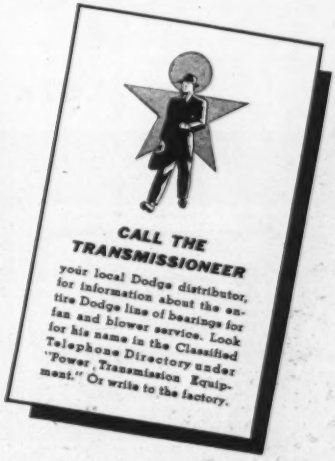
BALL BEARING PILLOW BLOCK

Single row, deep groove ball bearings. Inner race extended to form sleeve which carries shaft. Piston ring seals retain lubricant, exclude dirt. For arrangement No. 2. Shaft sizes 15/16" to 2-1/4".



BRONZE BUSHED PILLOW BLOCK

Designed for arrangement No. 2 installations. Two bronze bushings of high lead content and T section rings, sealed against dirt. Composition rings inside thrust collar prevent oil leakage. For shaft sizes 15/16" to 2-3/16".


CALL THE
TRANSMISSIONEER
your local Dodge distributor, for information about the entire Dodge line of bearings for fan and blower service. Look for his name in the Classified Telephone Directory under "Power Transmission Equipment." Or write to the factory.

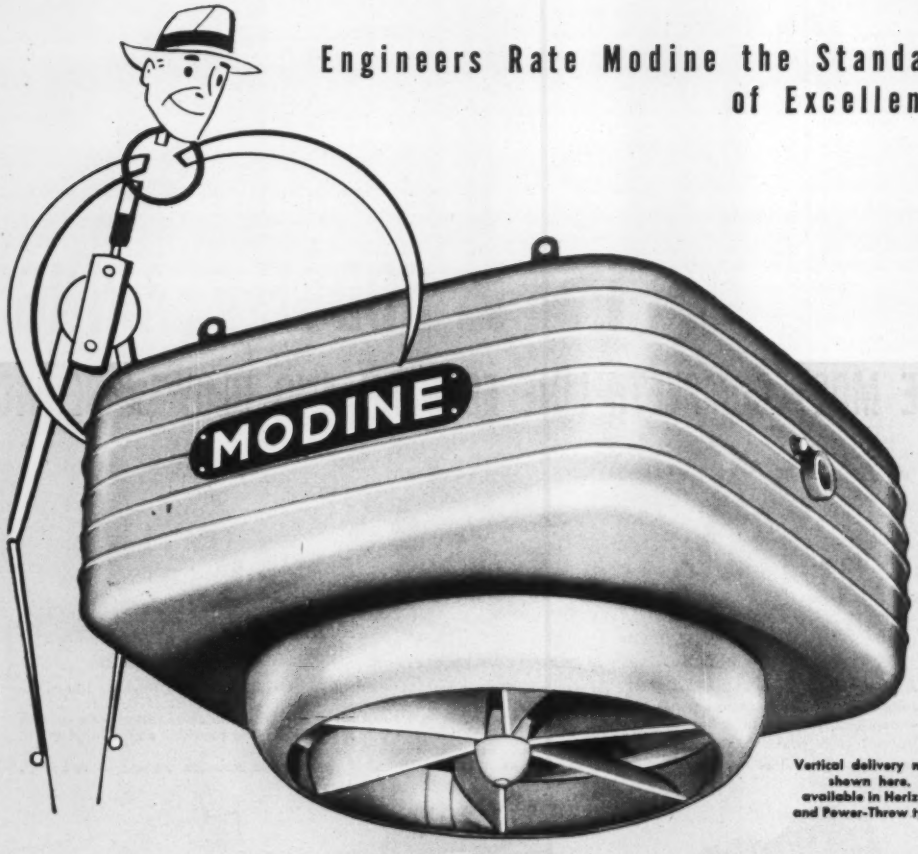
DODGE MANUFACTURING CORPORATION
1600 UNION ST., MISHAWAKA, IND.

DODGE
of Mishawaka, Ind.

FIRST IN POWER TRANSMISSION MACHINERY

FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, CHICAGO THRIFT ETCHING CORPORATION, 1600 N. SHEFFIELD AVE., CHICAGO, ILLINOIS

Engineers Rate Modine the Standard of Excellence



Vertical delivery model shown here. Also available in Horizontal and Power-Throw types.

Six of many outstanding features that

Modine design promotes mixing of room air and heated air leaving condenser. Result: increased air volume and velocity . . . lower outlet temperatures.

Parker-Bonderizing provides rust-resistance for casings and other sheetmetal parts — anchors paint to steel — preserves the fine finish longer.

Versatile control of air delivery is provided by Cone-Jet, Truncone or Louvre deflectors. You can choose the *right* one for your job at no extra cost.

COMPARE FIRST

...YOU'LL CHOOSE MODINE UNIT HEATERS

Advanced engineering... superb styling... highest grade materials and craftsmanship — all quality hallmarks of Modine Unit Heaters. They're your assurance of *heating performance at its best* — high fuel economy... years of trouble-free service. Built to a standard of excellence — Modine is the choice for unfailing dependability, lower operating and maintenance costs. So whether you need Vertical Delivery Models (illustrated), Horizontals or Power-Throws — *compare first!* Modine Mfg. Co., 1509 De Koven Ave., Racine, Wis.

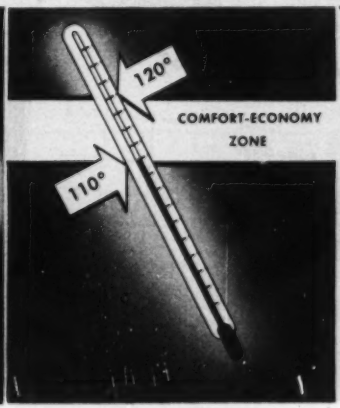
U-1111

Write for Bulletin 149-A, "Modine Unit Heating." Or contact your Modine representative listed in the classified section of your phone book.

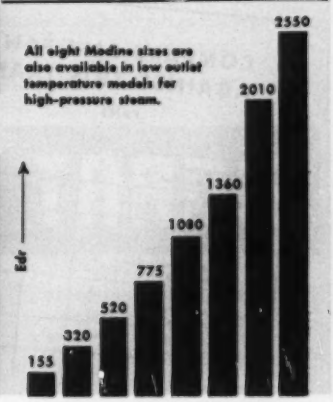
Modine UNIT HEATERS

account for the Modine quality reputation

Cooling sleeve protects motor when fan is not operating — safeguards against condenser radiant heat. A frequent cause of failure on ordinary heaters.

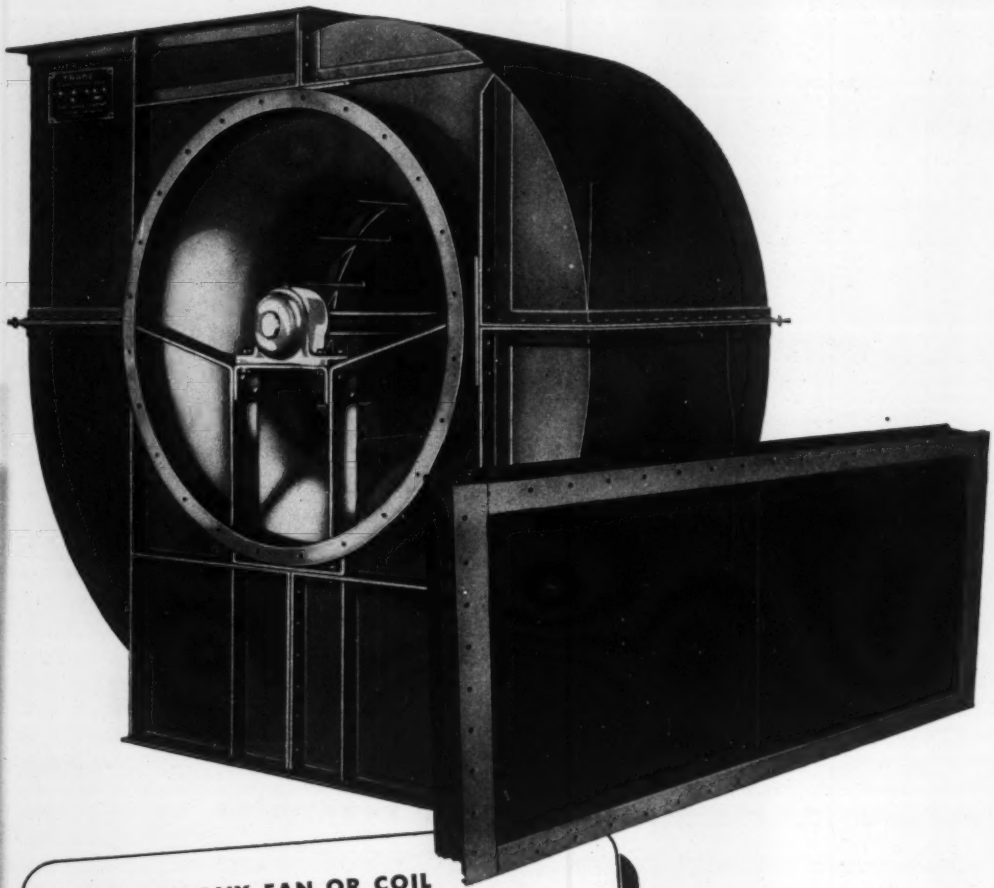


Discharge air temperatures of 110°-120° F. are correctly related to air velocities — assure perfect heating comfort plus lower fuel costs.



Big Modine Vertical Units for big defense plants eliminate expensive ductwork, retain the flexibility necessary for subsequent changes in plant layout.

LESS HORSEPOWER AND



COMPARE ANY FAN OR COIL AGAINST THIS TRANE CHECK LIST

FANS

Feature	Trane	Fan A	Fan B
Chlorinated Rubber Enamel	X		
Formed Inlet Openings	X		
Uninterrupted Duct Collar	X		
Welded Construction (Large Fans)	X		
Lock Seam Construction (Small Fans)	X		
Full Capacity Fan Wheels	X		
Fan Blades as heavy as 7 gauge	X		

COILS

Feature	Trane	Coil A	Coil B
Kinetic Orifice	X		
Plate-Type Fin	X		
Dual-Fin Contact	X		
Mechanical Bond of Fin and Tube	X		
Bushed Tube to Header Joint	X		
Provision for Proper Tube Expansion	X		
Wide Coil Channels—2¼"	X		

THE KINETIC ORIFICE, the patented Trane feature, releases steam in the direction of condensate flow in steam distributing tube coils. Drainage of condensate is accelerated. Stratification and freezing is eliminated.

MANUFACTURING ENGINEERS

BETTER PERFORMANCE

WITH THIS TRANE CENTRAL SYSTEM COMBINATION

You get triple value when you combine Trane Centrifugal Fans and Trane Coils in a central system. You get outstanding products loaded with exclusive features. You get the rugged construction that has made Trane famous. And, you get the added advantages that come only when you combine matched products. *Together Trane Centrifugal Fans and Trane Coils create a central system that produces top performance with less horsepower than any similar combination.*

Here's why:

Thanks to modern design, the average horsepower requirements of Trane Fans is lowest in the industry. Trane Coils with their streamlined bond of tube and flat plate-like fin offer minimum resistance to air flow. Combine a low horsepower fan and a low air friction coil and power demands shrink accordingly. That means you get greater efficiency and lower operating costs.

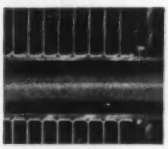
Rugged Construction for Consistent Performance—Then for long life and consistent performance, Trane gives you rugged construction in both products. Compare Trane Fan construction. Part for part, Trane uses metal that is as heavy or heavier than any other manufacturer.

Trane Coils use extra heavy tubing. Coil supports are equally strong. The Trane fin-and-tube construction with its solderless mechanical bond is designed to last a lifetime.

Lower Noise Level Fans—Besides low horsepower and heavier construction, other Trane Fan features include lower noise levels; more accurate fit and tolerance for consistent performance; chlorinated rubber base paint finish to prevent corrosion. Also featured is the uninterrupted collar for easy connection with duct work.

Coil Capacity Increased 15%—First in Trane Coil advantages is the kinetic orifice. This exclusive development in steam distributing tube coils increases capacity as much as 15%. Additional exclusive Trane features—six-step manufacture of fins to insure even heat flow—dual-fin contact that makes the fins an integral part of the tubes and speeds heat transfer—the guide flange assembly that permits expansion of the tubes for longer coil life.

There's similar extra value when you combine other matched products from the complete Trane line of heating, cooling, ventilating and air conditioning equipment. Each product is studded with exclusive features, each offers more rugged construction. And when you combine them in complete systems you get added features such as the less horsepower better performance of Trane Fans and Coils.



DUAL-FIN CONTACT is illustrated in this cutaway section of a Trane Coil. Collar of one fin is extended to next fin to form uninterrupted surface for continuous flow of heat.

ACCURATELY STREAMLINED FAN INLET CONE makes possible even distribution of the air in the fan wheel without noisy turbulence—permits fan to operate at highest efficiency with lowest noise level.

SPLIT FAN HOUSING permits easier installation. On large units, housings can be split on horizontal and vertical plane so fan parts can be moved through small openings and reassembled.

TRANE

THE TRANE COMPANY, LA CROSSE, WIS.
Eastern Mfg. Division, Scranton, Pennsylvania
Trane Company of Canada, Ltd. . . . Toronto
OFFICES IN 80 U.S. and 14 CANADIAN CITIES

OF HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

selective control

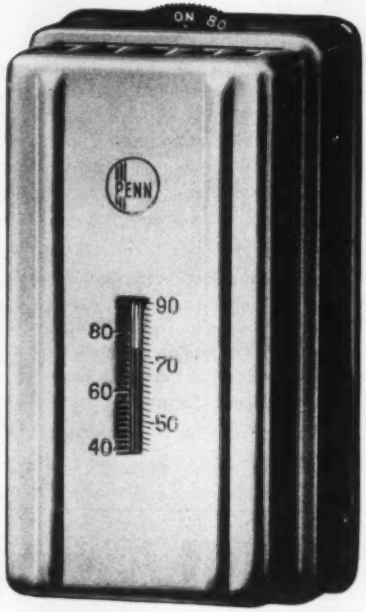
for Unit Heaters gives greater fuel economy year 'round efficiency!

In plant after plant . . . results are always the same. When *each unit heater* is controlled by a PENN heat-anticipating thermostat with the famous *built-in "ON-OFF" switch* . . . fuel saving and year 'round efficiency go up!

During winter months, the PENN heat anticipating thermostat holds temperatures closely to the selected level . . . wasteful zig-zag heating is eliminated. Then the "ON-OFF' switch prevents heat from pouring into areas where it's not required. A mere rotation of the dial to "OFF" position stops heat flow during idle plant periods . . . or to little-used areas . . . or to areas exposed for long periods to outside temperatures such as receiving or shipping rooms.

In summer months, this same "ON-OFF' switch permits manual control of fan operation for ventilation *without* installing an additional switch.

Learn more about this *better control* for unit heaters. Ask your manufacturer, wholesaler or write **Penn Electric Switch Co., Goshen, Ind.** Export Division: 13 E. 40th Street, New York 16, U.S.A. In Canada: Penn Controls, Ltd., Toronto, Ont.

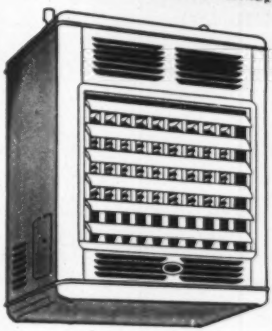


PENN

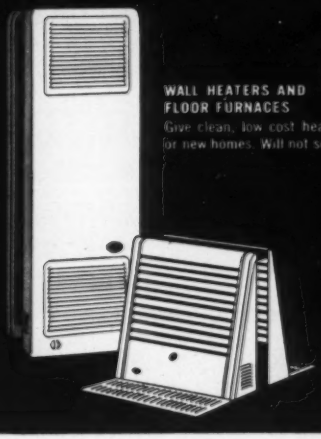
AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, PUMPS, AIR COMPRESSORS, ENGINES, GAS RANGES

UTILITY

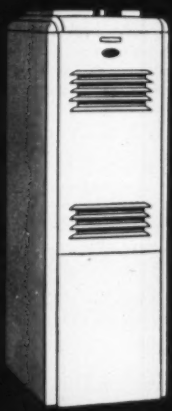


UNIT HEATERS
Furnish efficient "spot heating" in stores, plants, schools, churches and recreation centers.



WALL HEATERS AND FLOOR FURNACES
Give clean, low cost heat in old or new homes. Will not soil walls.

FORCED AIR FURNACES
Provide the finest in automatic, quiet, warm-air-heat for larger homes, etc.



Utility builds more sales for you

HERE'S WHY: The wide range and variety of Utility Gas Heating Equipment gives more models to choose from—one to fit every problem and every purse. Soundly engineered and sturdily constructed, Utility equipment gives years of satisfactory customer operation. This builds business for you year after year. Feature the *complete* Utility line for more profits. Write *now* for information about Utility dealerships. For year-'round business, sell Utility Cooling, too!

UTILITY TRADE MARK — Guaranteed Heating Performance

UTILITY APPLIANCE CORP. 4851 So. Alameda St., Los Angeles 58, Calif.

The Nation's Foremost Manufacturer of Evaporative Air Coolers... Utility Gas Heating Equipment... Gaffers & Sattler and Occidental Automatic Gas Ranges

Carey duct ALL-

Eliminates 5 Major

Careyduct is an improvement over scarce metal ducts —not a substitute. Insulated and Acoustical Careyduct—*the duct with revolutionary new advantages*—combines insulating and acoustical values in one strong, rigid duct, *yet costs no more installed than insulated metal ducts.*

This greatly improved air duct *eliminates* these 5 major installation headaches—(1) requires no cutting of plaster for furring; (2) needs no insulation; (3) no acoustical treatment necessary; (4) no erecting of expensive supporting framework, and (5) permits installation in occupied buildings. You save on time and labor costs . . . enjoy greater margin of profit.

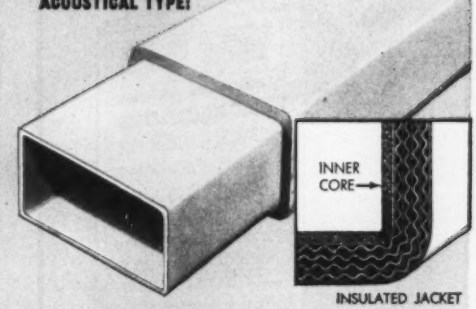
Careyduct is superior to metal in many ways. It's lighter in weight, easier to handle! Absorbs sound, won't *telegraph* fan or other noise! And its smooth surface takes readily to paint or other decorative treatments.

Careyduct is the *only* duct material that carries the added selling punch of the Underwriters' Laboratories label. It's asbestos throughout, has been job-proved in important industrial, commercial and industrial projects the country over. Careyduct comes prefabricated to exact specifications, and is available for *fast delivery.* Simple, slip-joint construction and standardized parts provide easy, rapid fitting on the job.

For Air Conditioning Systems

"I & A" CAREYDUCT

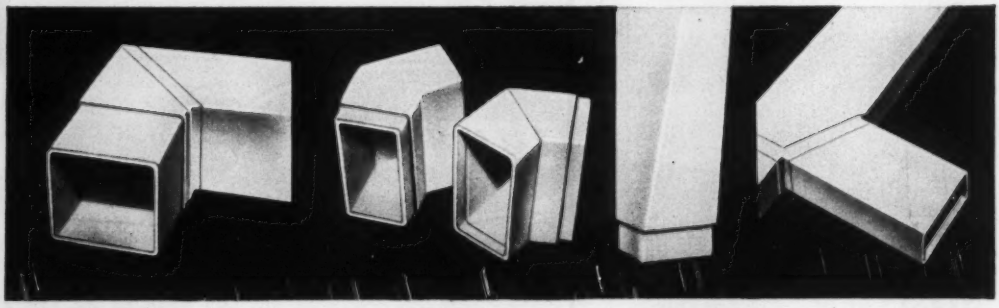
INSULATED AND ACOUSTICAL TYPE:



Carey duct answers every duct problem

"I&A" Careyduct assures quiet, efficient air conditioning systems in new buildings or old. Absorbs sound; won't telegraph fan grumbles and other noises, and handles air velocities up to 2500 feet per minute with ease. As a result, smaller duct sizes can be installed where space or clearance is limited. "I&A" Careyduct consists of two telescoping sections 3 ft. long—an inner-core of high density and strength, plus an outer shell of fine corrugated asbestos.

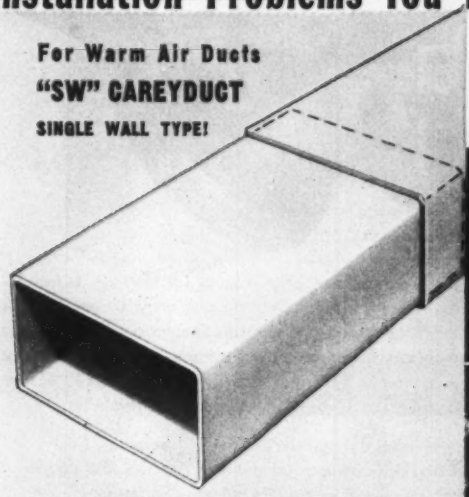
Careyduct is available in these shapes for quick on-the-job installations!



90° ELBOWS | 45° ELBOWS | TAPER SECTIONS | SIDE OUTLET TAKE OFF

ASBESTOS AIR DUCT

Installation Problems You Now Face With Metal Ducts!

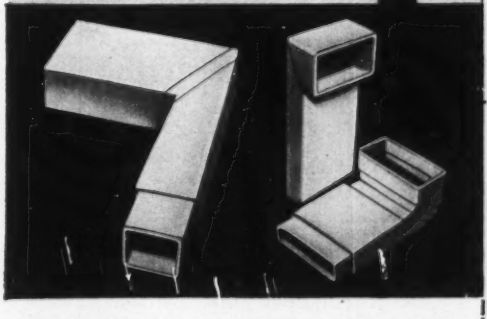


comes in two easy-to-install types!

"SW" Careyduct is used principally for residential and industrial warm air heating systems. Careyduct eliminates cracks, pops and creaks that occur in metal ducts during furnace "on" and "off" periods —while its insulating properties conserve fuel, speed furnace-to-room heat-up time. The three-foot sections are joined by a collar, similar in texture and thickness to the duct itself.

"SW" Careyduct is also highly recommended for cold air returns and ventilating conduits.

For quick facts about Careyduct, send for your FREE copy of our illustrated Careyduct Manual.



INCREASING ELBOW STACKHEAD

SIZES Careyduct, I&A and SW types, come in a range of sizes from 2½" x 5½" to 17½" x 35½" in width. Also in round sections from 3" to 30" in diameter.

TYPICAL *Carey duct* Installations!

Commercial Air Conditioning Duct System!

Residential Warm Air Heating System!

Schools, Churches, Studios!

Everywhere, architects, suppliers and contractors are conserving scarce metals by *specifying*, *selling* and *installing* better-than-ever Careyduct. If you're missing this once-in-a-lifetime profit opportunity, contact your Carey representative, or write, wire or phone . . .

The Philip Carey Mfg. Company, Lockland, Cincinnati 15, Ohio

Carey

In Canada: The Philip Carey Co., Ltd., 227 Duke Street, Montreal 3, P. Q.

The Philip Carey Mfg. Company, Lockland, Cincinnati 15, Ohio, Dept. HP-9
Please send me your Careyduct Manual. I understand I will not be obligated in any way.

Name_____

Firm_____

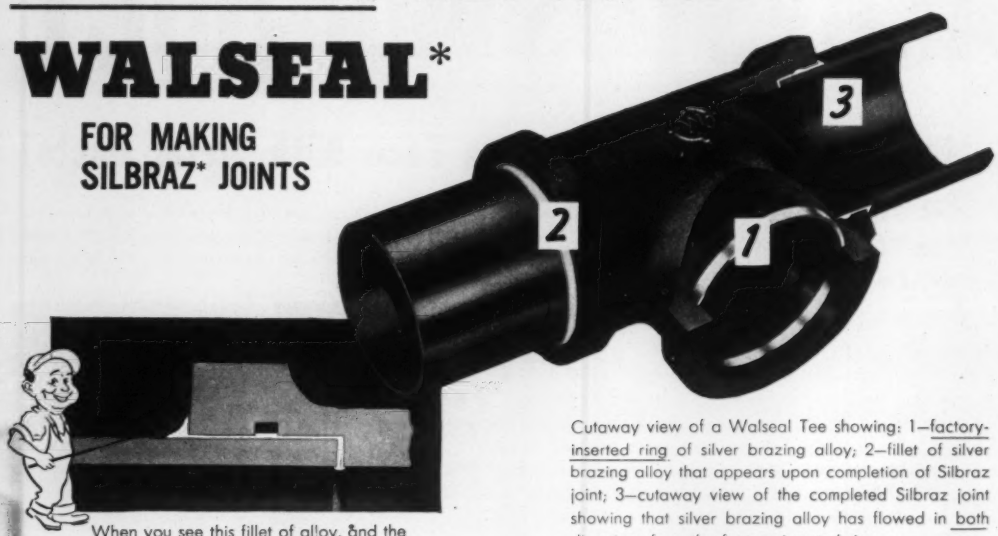
Address_____

City_____ Zone____ State_____

NOBODY GUESSES WHEN YOU USE . . .

WALSEAL*

FOR MAKING SILBRAZ* JOINTS



When you see this fillet of alloy, and the fitting is Walseal you know that you have penetration because the alloy comes from the inside.

Cutaway view of a Walseal Tee showing: 1—factory-inserted ring of silver brazing alloy; 2—fillet of silver brazing alloy that appears upon completion of Silbraz joint; 3—cutaway view of the completed Silbraz joint showing that silver brazing alloy has flowed in both directions from the factory inserted ring.

When you make Silbraz* joints in your brass, copper, or copper-nickel pipe lines with Walseal Valves, Fittings, or Flanges you know you have the right amount of the correct type of silver brazing alloy. The ring of Sil-Fos brazing alloy is factory-inserted in the ports of Walseal products at the time of manufacture.

No lost time or motion in handling the alloy . . . no difficulty in getting full penetration of the alloy regardless of the position of the valve or fitting . . . no guessing whether the joint is made right . . . the fillet of alloy that shows up when the Silbraz joint is completed, comes from the inside!! And, whether you've made the Silbraz joint yourself, or inspecting the work of another, you know that if the silver alloy fillet is visible, and the valve or fitting is Walseal, you have full penetration. That's why nobody guesses when you use Walseal!

Walseal products are backed by the reputation of the Walworth Company, manufacturers of valves and pipe fittings since 1842.

For full information regarding Silbraz joints made with Walseal products, write for Circular 84.

*Patented—Reg. U. S. Pat. Off.

Recommended for

- **Hot and Cold Water Circulating Systems**
- **Boiler Feed Lines**
- **Steam Return Lines**
- **Condensate Lines**
- **Low and High Pressure Air Systems**
- **Lubricating Oil Circulating Systems**
- **Industrial Gas Piping**
- **Solvent and Vacuum Piping Systems**

Make it "a one-piece pipe line" with WALSEAL

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

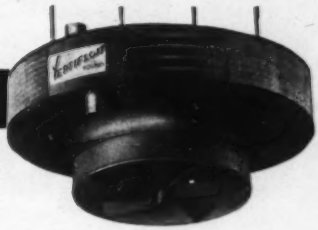
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

What's Your HEATING PROBLEM?

Young "SH" Unit Heater

COLD SPOTS?

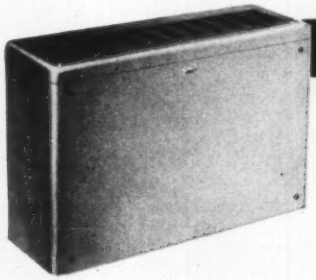
A favorite for general space heating and eliminating "cold spots" in large areas is the Young Type "SH" horizontal discharge unit heater. These non-ferrous-core units deliver maximum heat transfer . . . use quiet and efficient fans. Available in 14 sizes, with capacities ranging from 19,000 to 325,000 Btu per hour.



Young "Vertiflow" Unit Heater

EXTRA HIGH CEILINGS?

Patented "Vertiflow" design offers a rugged, compact, highly efficient unit with low hp requirement. Its exclusive motor "ventilation" feature eliminates burn-outs from core heat. Seven sizes range from 52,600 to 552,000 Btu per hour, and cover larger areas quicker, with fewer units. Diffusers, nozzles, and Anemostats provide any heat pattern desired.



Young Cabinet Unit Heater

DRAFTY AREAS?

Here's the ideal heating unit for lobbies, vestibules, auditoriums, etc. . . . wherever concentrated heating capacities are required and a compact, attractive exterior design is necessary. They are available in 3 sizes of each of 3 styles offering heating capacities ranging from 26,200 to 115,000 Btu per hour.

YOUNG

Heat Transfer Products for Automotive and Industrial Applications.

Young Quality

Reg. U. S. Pat. Off.

Heating, Cooling, Air Conditioning Products for Home and Industry.

YOUNG RADIATOR COMPANY

Dept. 511-J, RACINE, WISCONSIN

Factories at Racine, Wisconsin and Mattoon, Illinois

Sales and Engineering Representatives in All Principal Cities

THIS COUPON BRINGS FULL DETAILS ON THREE SOLUTIONS TO HEATING DIFFICULTIES

YOUNG RADIATOR CO.

DEPT. 511-J

RACINE, WIS.

Rush me information on the following Young Unit Heaters:

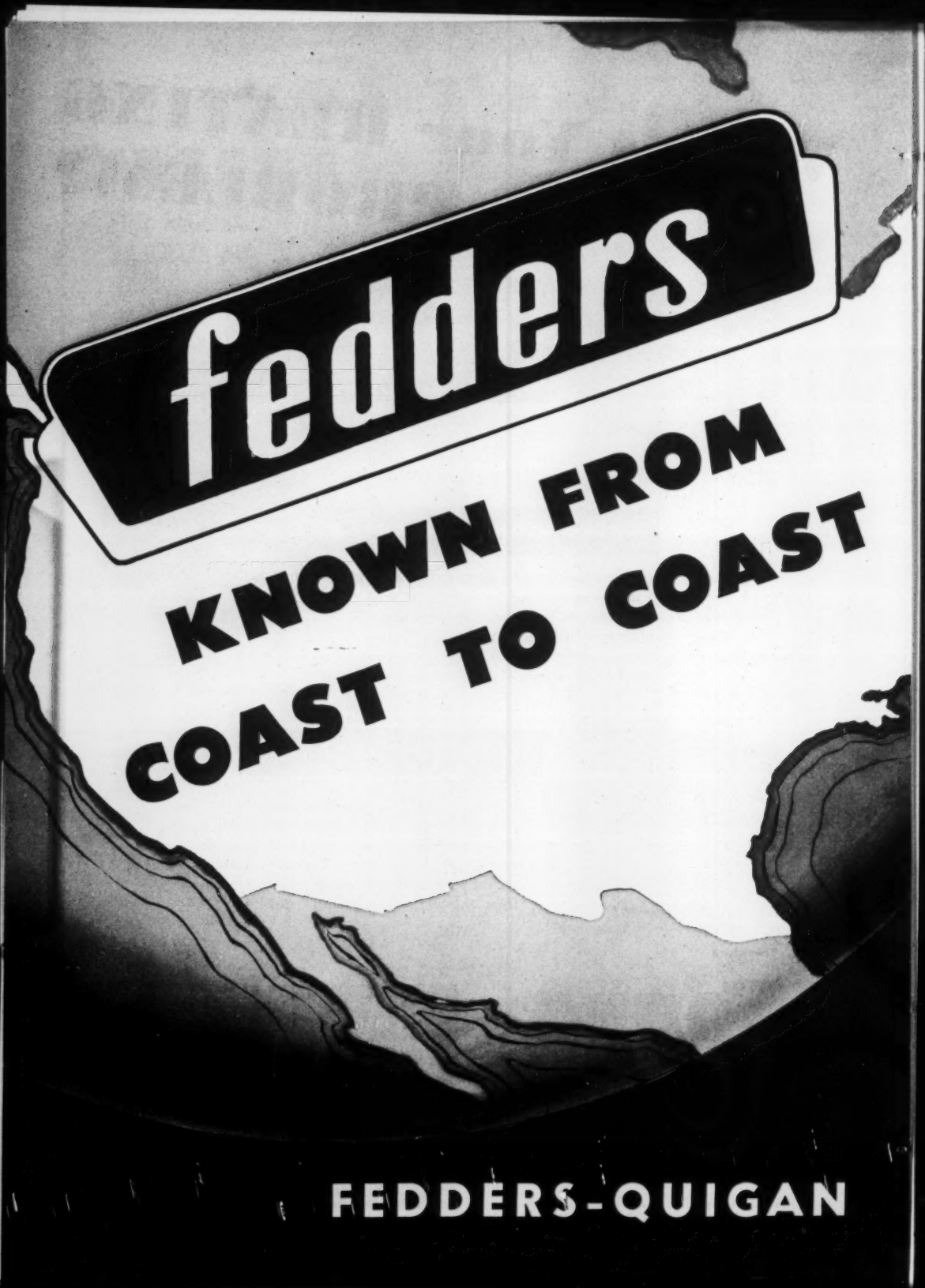
☐ "SH" ☐ "Vertiflow" ☐ Cabinet

Name_____

Company_____

Address_____

City_____ Zone____ State_____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KNOWN FROM
COAST TO COAST
FEDDERS-QUIGAN

CORPORATION BUFFALO 7, N. Y.

Wheatland *precision* Couplings

There's no room left for any doubt in the precision fittings of a submarine. These man-made leviathans of the deep must be tight —*and we mean tight*— from stem to stern because their very life is a constant test of tightness.

There's no room left for any doubt, either, in the making—or *fitting*—of Wheatland precision couplings because their performance, too, is absolutely dependent upon their *tightness*. That's why men who know pipe demand *Wheatland*— the very best in couplings.

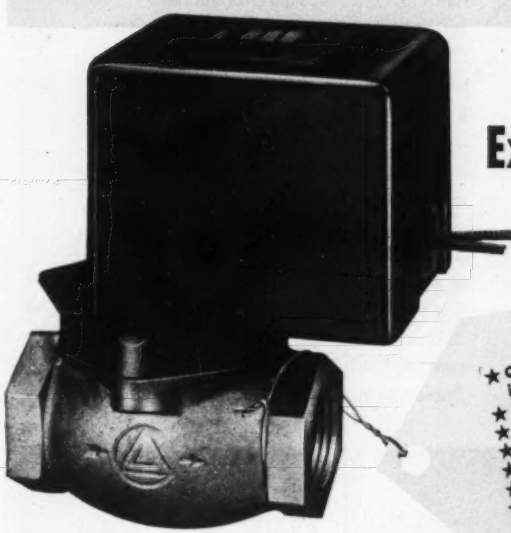
precision couplings by

WHEATLAND STEEL PRODUCTS COMPANY

Bankers Securities Bldg., Philadelphia 7, Pa.

Help keep America strong and free. Get in your scrap now—*today!*

demand DETROIT CERTIFIED CONTROLS



This Exclusive Combination of DETROIT Features

V-579 "BI-FLEX" GAS VALVE

- ★ Quiet operation—no click, no hum. An ideal replacement for noisy valves.
- ★ Rugged, compact design—easy to service.
- ★ Inexpensive.
- ★ Adaptable to all gases.
- ★ "Bi-flex" motor operated—low voltage.
- ★ Temperature and voltage compensation.
- ★ Snap-action opening and positive closing.
- ★ ½ inch to 1¼ inch sizes.

The exclusive features of the V-579 "Bi-flex" Gas Valve prove that you get more for your money when you deal with DETROIT. You can always count on giving your customers a better job when you install any DETROIT control. DETROIT controls are designed and built to fill your customers' needs—to give real economy and reliability through years of trouble-free service. The V-579, for example, at low initial cost, gives your customers an exclusive combination of outstanding features which provide new standards for the efficient and quiet operation of modern gas burning equipment. And that's exactly the kind of operation that pays off with more comfort for the user, more sales and profits for you. So take advantage of this extra value—insist that your source of supply furnish DETROIT controls with all your heating equipment. Write for Bulletin No. 229.

Means More Comfort for your Customers

More Profits for You!

No. 411 Thermostat—A sensitive and accurate *Timed Cycling* thermostat for all types of heating systems. Provides close control of room temperature. Attractively styled, easily installed and adjusted. Write for Bulletin No. 193 and Form No. 1545.

DETROIT LUBRICATOR COMPANY

5900 TRUMBULL AVE., DETROIT 8, MICHIGAN

Division of American Radiator & Standard Sanitary corporation

RAILWAY & ENGINEERING SPECIALTIES, LTD.
Canadian Representatives in Montreal, Toronto, Winnipeg.

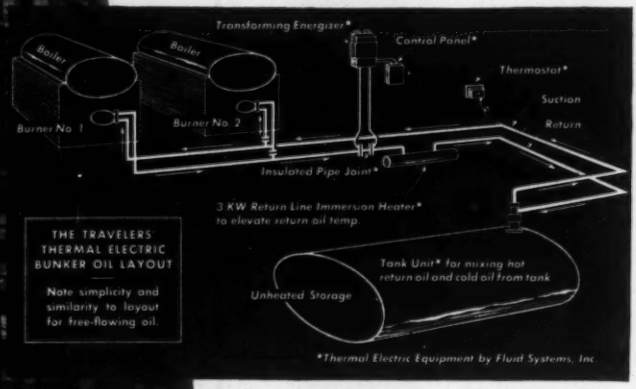
DETROIT

DETROIT HEATING AND REFRIGERATION CONTROLS • ENGINE SAFETY CONTROLS • FLOAT VALVES AND OIL BURNER EQUIPMENT • DETROIT EXPANSION VALVES AND REFRIGERATION ACCESSORIES • STATIONARY AND LOCOMOTIVE LUBRICATORS

Serving home and industry AMERICAN STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KELVINATOR RUUERS • KOLS HEATER • TONAWANDA IRON

'The Travelers' Buys Bunker Insurance!

THE TRAVELERS Insurance Company of Hartford, Conn., has long-term insurance against bunker oil heating problems. They use a Thermal Electric Standard System to remove bunker oil from *unheated* storage and transport it to the pump-type burners at a precisely controlled flow temperature. ☆ Fully automatic, all-electric operation eliminates remote pump-sets, multiple suction lines, and complicated recirculation equipment. This gives Travelers extra dividends in the elimination of maintenance costs for bunker transport. ☆ We write insurance, too. We've *guaranteed* the Travelers installation, as we guarantee all correctly installed Thermal Electric Standard Systems, to give 100% trouble-free performance!



THE TRAVELERS THERMAL ELECTRIC BUNKER OIL LAYOUT

Note simplicity and similarity to layout for free-flowing oil.

HOW IT WORKS

The Thermal Electric Transforming Energizer passes safe 20-volt current through the pipes that carry the fuel, generating even heat. The Thermostat and Control Panel automatically regulate the fuel temperature at 120°F. During shutdown, fuel can be kept heated in the pipes without constant or cycle burner operation. System can be shut off without draining — Thermal Electric will melt out the pipes electrically.

Send in the coupon and get the whole story of how Thermal Electric can give you the same advantages.

PAT. NO. 2,224,402

Thermal Electric Fluid Systems Inc.

Fluid Systems, Inc., 1881 Dixwell Ave., New Haven, Conn.

Please send without obligation "The Common Sense of Heavy Fuel Transport" plus Customer List of hundreds of users, including many insurance firms.

Name _____

Firm _____

Street _____

City _____ *State* _____

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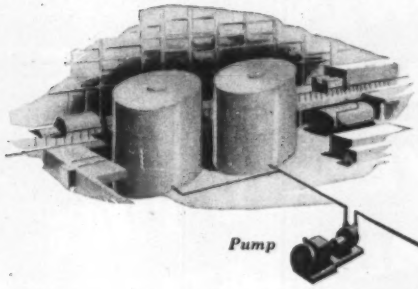
Thermal Electric and Fluid Systems, Inc. are trade marks registered in U.S. Pat. Off.

Making Wax Work for American Can Company



Liquid paraffin is a temperamental fluid. If it gets too cool, it clogs. If it gets 5°F. too hot, it oxidizes, making it unfit for use. Thermal Electric, the modern method of transporting heated fluids, can regulate paraffin within ±1°F. of the design temperature (usually 160°F.) over any distance, through any variety of ambient temperatures, during any condition of flow. ☆ There is no need for constant circulation, thus there are no return lines. *One-way transport reduces piping 70%.* All-electric operation eliminates steam or water heating with all their costs and maintenance headaches. ☆ Small wonder that this leader in the food container field has consistently selected Thermal Electric to handle its process fluids!

The American Can Company uses 79 Thermal Electric systems to heat 8,016 feet of pipe in nine plants. The Thermal Electric principle of passing low-voltage current through the pipe walls works with any fluid. Canco uses Thermal Electric for paraffin, asphalt, outdoor water lines, and sealing compound.

★Thermal Electric equipment by Fluid Systems

PAT. NO. 2,224,402

Thermal Electric Fluid Systems Inc.

Fluid Systems, Inc., 1881 Dixwell Ave., New Haven 14, Conn.

Please send without obligation ☐ "Liquid Paraffin—A Survey of Handling Methods" or ☐ "Simplified Industrial Fluid Transport Cuts Costs".

Name _____ *Position* _____

Firm _____

Address _____

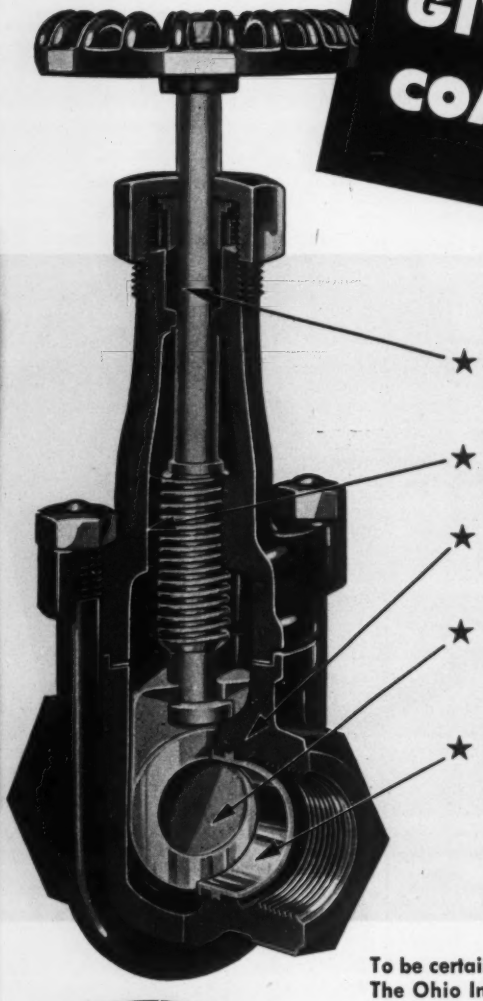
City _____ *State* _____

HPI-3

THERMAL ELECTRIC and FLUID SYSTEMS, INC. are trade marks registered in the U.S. Pat. Off.

Consult Fluid Systems, Inc., for specialized engineering aid in designing pipe transport of process fluids.

ONLY THESE CLIP GATES GIVE YOU THIS COMBINATION



STEM LIFE INCREASED 20 TO 30 TIMES Valve stems of the new OIC Alloy 40 offer greatest resistance to corrosion, wear and galling; no seizing.

This special, extra large duct permits complete drainage of the bonnet and prevents damage by freezing.

Thick, scientifically designed walls make OIC Valves strong and sturdy. No distortion.

Wide wedge prevents warping and allows plenty of space for accurate seating. OIC Clip Gates pass rigid tests; no oil or wax on seating surfaces to hide leakers.

Exclusive in OIC Clip Gates, 2" and under: Seats are cast in place and then rolled to make *doubly sure* they are tight and secure. Greatly superior to simply rolling in against machined surfaces.

To be certain of the best, ask for OIC Clip Gates.
The Ohio Injector Company, Wadsworth, Ohio.

OIC
FOUNDED 1887

VALVES

FORGED AND CAST STEEL · IRON · BRONZE

American Blower—a time-honored name in air handling

Venturafin Unit Heaters

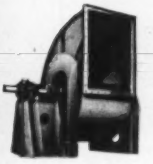
Mechanical Draft Fans

Utility Sets

Ventura Ventilating Fans

Dust Collectors

Air Washers



Industrial Fans

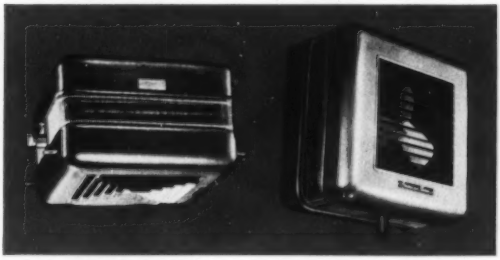
Heating and Cooling Coils

Air Conditioning Equipment

All air handling equipment is not alike. There's a vast difference in quality, design, quietness, operating costs and efficiency. Look before you buy and you'll buy American Blower products—the accepted quality standard—proved in test after test by buyers.

In Washington, as in other cities, American Blower Air Handling Products serve commerce, industry and public utilities. For air handling data in the Washington area, call American Blower—National 8120. Elsewhere, consult your phone book.

Product of the month



Ceiling-mounted Vertical Unit Heater.

Wall-mounted Venturafin Unit Heater.

Unit Heaters save fuel

In any plant or business, to insure customer satisfaction and add to your profits, recommend and install American Blower Unit Heaters.

American Blower Unit Heaters, for steam and hot water heating, are available in vertical and horizontal models, for wall and ceiling installations. All carry Certified Ratings, contain heavy-duty coils and are sound-rated.

Modern, die-formed steel casings completely enclose all moving parts, an important safety factor. Unobstructed outlets allow maximum heat diffusion throughout the entire working area, assuring comfortable final temperatures.

For complete information, call the nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

YOUR BEST BUY AMERICAN BLOWER AIR HANDLING EQUIPMENT

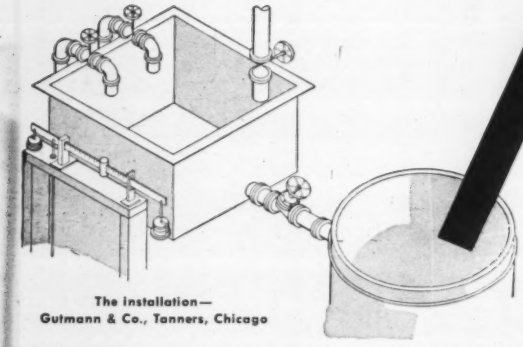
Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

for outstanding service

on Chrome Tanning Liquor

. . . for example



The installation—
Gutmann & Co., Tanners, Chicago

PROBLEM: To find a better replacement for valves and cocks used on outlet of open scale tank. Constant trouble with seat leakage, corrosive wear, seizing, and stuffing box maintenance.

WORKING CONDITIONS: Solution handled—highly corrosive basic sulphate of chrome used in tannage of Chrome upper leather. Several batches mixed daily. Gravity flow from scale tank.

SOLUTION TO PROBLEM: Crane No. 1615 Iron Body, packless Diaphragm Valve, Neoprene lined, featuring separate disc and diaphragm design.

RESULT: After more than 2½ years of steady, leak-free service, Crane Diaphragm Valve shows no sign of corrosive or erosive effects . . . no undue mechanical wear . . . operates as smoothly as new. Maintenance cost to date—zero.

Another typical case history demonstrating how Crane Quality Valves assure low ultimate cost. And why . . . More CRANE VALVES are used than any other make!

. . . Switch to Performance-Proved CRANE VALVES

No. 1615 Crane Iron Body Diaphragm Valve. Get literature on this full line of multi-purpose valves from your Crane Branch or Crane Wholesaler.

CRANE CO.

General Offices:
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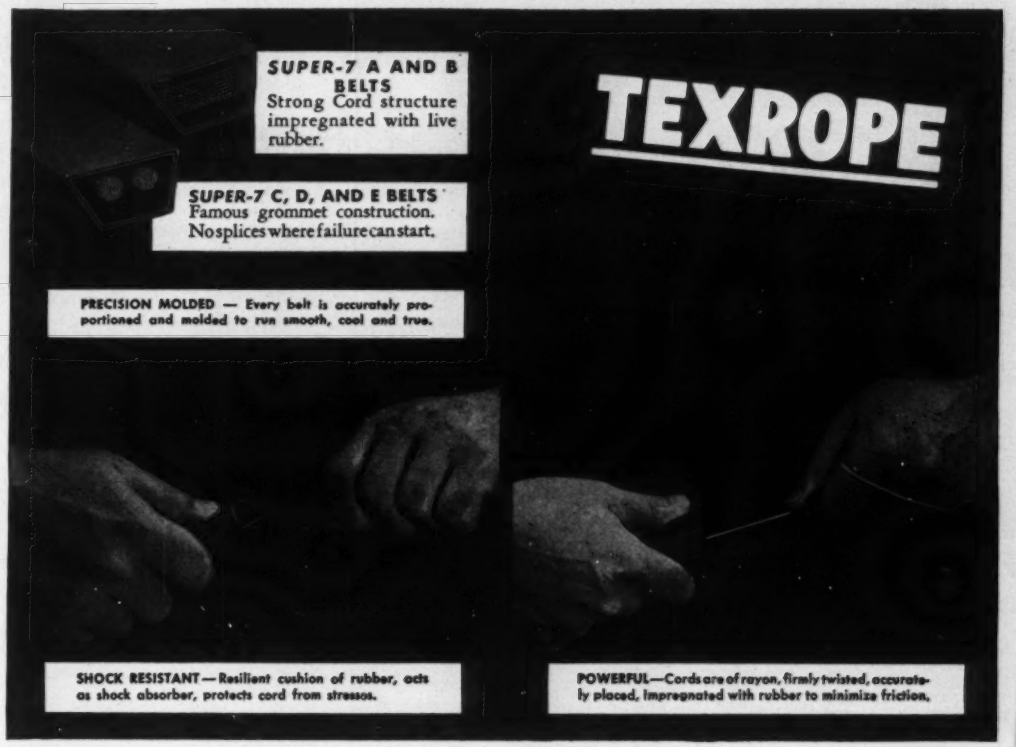
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING


SUPER-7 A AND B BELTS
Strong Cord structure impregnated with live rubber.
TEXROPE
SUPER-7 C, D, AND E BELTS
Famous grommet construction. No splices where failure can start.
PRECISION MOLDED — Every belt is accurately proportioned and molded to run smooth, cool and true.
SHOCK RESISTANT — Resilient cushion of rubber, acts as shock absorber, protects cord from stresses.
POWERFUL — Cords are of rayon, firmly twisted, accurately placed, impregnated with rubber to minimize friction.

Cool Running...LONG LIVED!

SUPER-7 V-belts give long, satisfactory service even under bad conditions of load, shock and grit.

Tough, double-wrapped cover bias cut for elasticity and impregnated with rubber. Effectively seals out dust, grit, moisture; takes the wear; keeps the belt in shape; and protects cord structure.

But you get more than good belts when you standardize on *Super-7* V-belts. You also get the benefit of the greatest V-belt experience in the world both in the field and factory. You are assured of exactly the right drive for longest life from the wide variety of types and sizes available.

High Capacity Belts

Where space is limited or other special conditions demand heavier duty, the high capacity belt can be furnished in A, B, C, D, and E sections . . . Extra strong cords, special rubber cushion and tough Neoprene cover give them 40% greater capacity than standard belts at proportionately higher price.

V-Belt Drive Headquarters

Your nearby Allis-Chalmers Authorized Dealer or Sales Office can serve all your V-belt needs, whether they be new or replacement V-belts; standard and variable speed sheaves; or speed changers.

Get your copy of the revised 120 page *Texrope* Pre-Engineered Drive Manual from your A-C Dealer or Sales Office or write for Booklet 695A. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3291

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Applied . . .
Serviced . . .

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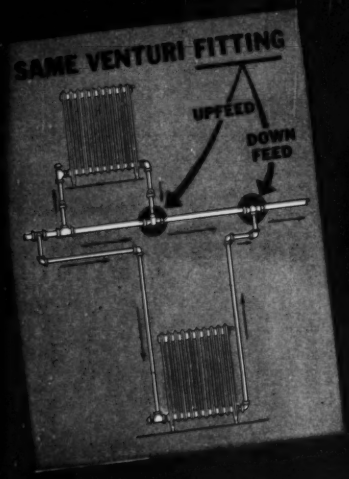
MOTORS — ½ to 23,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

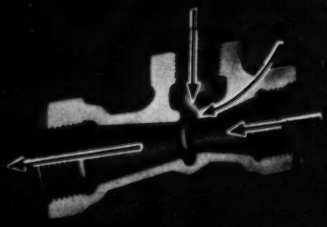
PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

ALLIS-CHALMERS

You use ONLY ONE Taco Venturi Fitting per radiator...on the return (*use an ordinary tee on supply*)

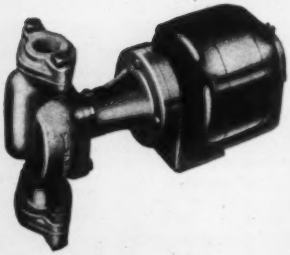


HOW IT WORKS...



WORKS EQUALLY WELL WITH LOW HEAD AS WITH HIGH HEAD CIRCULATORS

4 GOOD PRODUCTS TO USE ON ALL ONE PIPE HOT



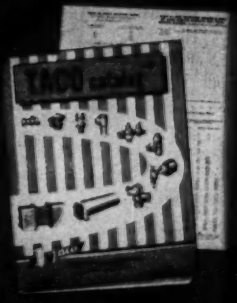
TACO HORIZONTAL CIRCULATOR

TACO VENT

TACO TYPE "B" TEMPERING VALVE

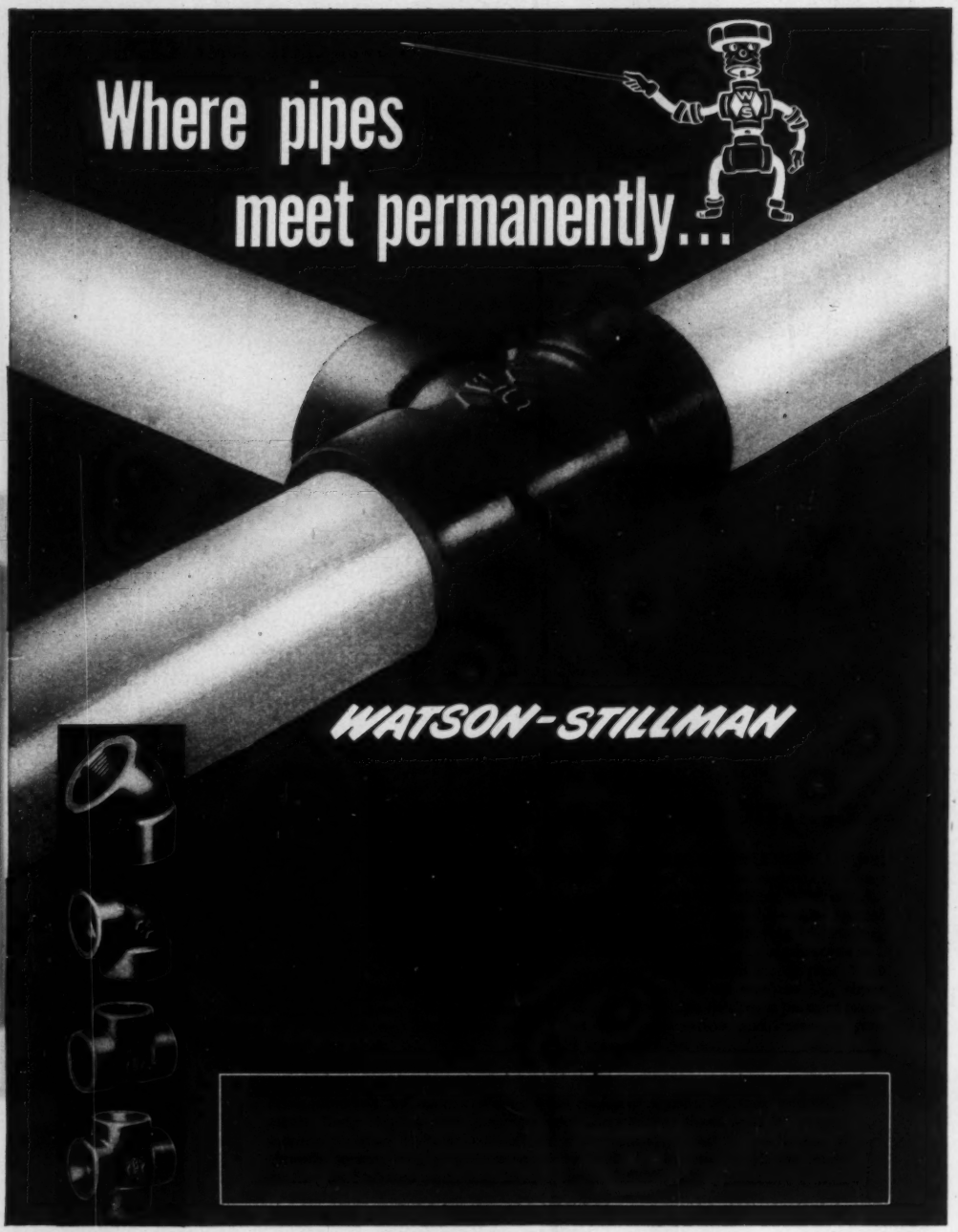
TRY THIS FOR YOURSELF

EASIEST WAY TO LAY OUT ONE PIPE HOT WATER SYSTEMS



WATER JOBS

TANKLESS TACO WATER HEATER



DISTRIBUTOR PRODUCTS DIVISION **WATSON-STILLMAN** ESTABLISHED 1848 • ROSELLE, NEW JERSEY

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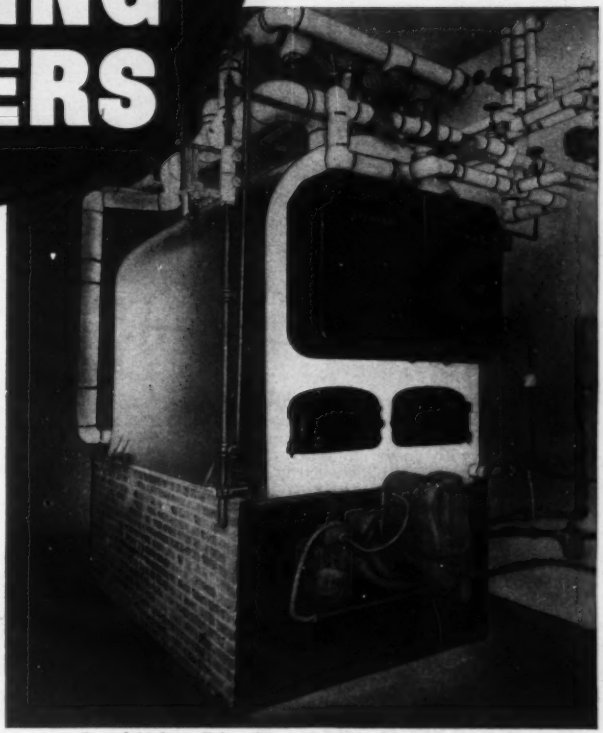
SPENCER

The Quality line of HEATING BOILERS



One of the four efficient Spencer Steel Heating Boilers which supply the fifteen buildings of the modern River Edge Apartments, River Edge, New Jersey.

● ***There is a Spencer for every building, for every fuel.***

Both cast iron and steel . . . a selection of 76 models . . . versatile, dependable, backed by more than sixty years of leadership . . . precision-engineered and manufactured to give superior, *guaranteed* service.

Write for Spencer Catalogue *today*.

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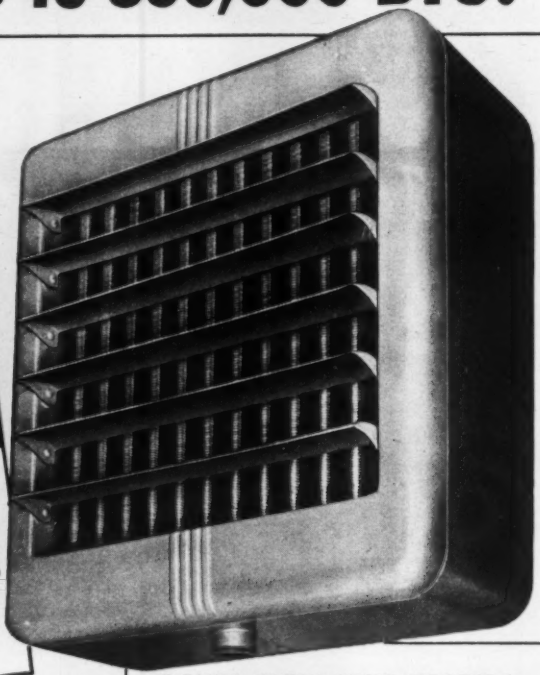
HEATER
LYCOMING-SPENCER DIVISION
WILLIAMSPORT PENNSYLVANIA

SBI

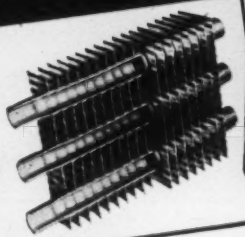
FROM 20,300 to 360,000 BTU!

Capacities to Match Your Requirements

McQuay HORIZONTAL UNIT HEATERS



ANOTHER RIPPLE FIN COIL APPLICATION



Within the wide range of BTU capacities, you're sure to find McQuay Horizontal Unit Heaters to fit your needs. Every unit has the exclusive Ripple Fin Coil construction . . . with these advantages: more heat transfer surface, greater flexible strength, cleaner operation . . . flexible copper tube headers that accommodate unequal expansion and contraction. Tubes expanded into fins having wide, smooth collars, without the use of any low conductivity bonding agents, provide a permanent mechanical bond. The famous Ripple Fin Coil plus modern cabinet styling, quiet motor fan assembly and Test Code Ratings add up to maximum performance and trouble-free service. Get all the facts from the McQuay representative in your city; or write to McQuay, Inc., 1601 Broadway St. N.E., Minneapolis 13, Minn.

DOWN FLOW UNIT HEATERS

This McQuay "vertical" unit heater, suspended near the ceiling, utilizes the warm air in that area and distributes it down to the floor level. No wasted heat, no cold spots. Four types of draftless diffusers available.

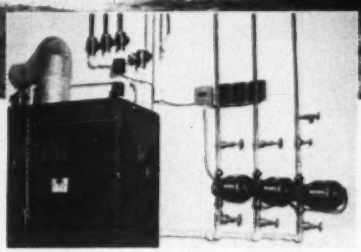
BLOWER TYPE UNIT HEATERS

For effective heat distribution over large open areas. Available in 8 sizes . . . in suspended and floor models, with one and two row coils; capacities from 23,800 to 1,659,000 BTU per hour.

McQuay INC.

HEATING • AIR CONDITIONING • REFRIGERATION

Today's most modern homes . . .



A SIMPLE ZONED SYSTEM

Notice the compactness of this three-zone Flow Control System and the inexpensive units used. Just a Circulator, a Flow Control Valve and a No. 201 Radiant Heat Control in each zone. There are no costly motorized valves no complicated devices to give trouble. Temperature in each zone is maintained automatically.

. . . are heated with THRUSH *forced circulating* HOT WATER HEAT

HERE'S a beautiful new home heated economically with forced circulating hot water, with radiant coils in the ceiling providing completely automatic radiant heat in any weather. Thrush Flow Control System of Forced Circulating Hot Water Heat assures highest efficiency . . . uniform temperatures in every room . . . with no overheating. Room temperature is controlled within a fraction of a degree separately in each of the three zones. This is the heating plant your customers want. See your wholesaler today or write Dept. E-9 for more information.

Horizontal Water Circulator

Vertical Flow Control Valve

Ask for folder on Thrush Forced Circulating Flow Control System of Hot Water Heating.

H. A. THRUSH AND COMPANY
PERU, INDIANA

DOLE-20

The No. 20 Dole Hot Water Air Valve is completely automatic. Operates equally well on forced or gravity systems. No preliminary soaking is necessary. Easy to install and adjust for automatic or manual venting, or use as manual shut-off.

ENGINEERED FOR

DOLE Hot Water Air and Vacuum VALVES

DOLE CHAMBER VENT

Combination air chamber and automatic air eliminator. Available in popular sizes.

DOLE FLOW CONTROL VALVE

It's simple and practical. Regulates water flow, limiting discharge to a predetermined gallonage regardless of water pressure from 15 to 150 lbs., p.s.i. No more cool water from overdrawn tankless heaters. Many other uses.

DOLE THERMOSTATIC AIR CONTROLS

Individual room temperature is automatically controlled by Dole Thermostatic Air Controls on forced warm air outlet. Whole systems are effectively and automatically balanced for better heating.

FRESH AIR "MADE TO ORDER"

Saves money!

Saves critical materials!

Make DOREX AIR RECOVERY part of your air conditioning or heating installation

Here's what we mean by "made-to-order" fresh air:

To maintain air quality, your ventilation system must continually bring in air from the outside. You have to heat or cool this air—which costs money. But when Dorex Air Recovery is part of the system, only about one-third as much outside air need be taken in. Dorex supplies the rest by making fresh air "to order" from the used air that has already been conditioned.

This is done simply by passing the used air through Dorex C Cells—containers of activated carbon that extract all odorous and gaseous impurities. The air you have already paid good money to heat or cool comes out just as fresh and usable as air from the outside.

Now, let's look closer at savings. You save critical materials because substantially less heating and cooling equipment is required. You save money because you have far less air to condition. On the basis of 20 years' experience and over 7,000 Dorex installations, you can safely figure a $400 saving on original equipment for every $100 invested in Dorex Air Recovery . . . and a $4 saving in operating costs for every $1 spent for Dorex maintenance.

Get the full story of Dorex Air Recovery. Mail the coupon today.

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Air Recovery

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Air Diffusion • Air Purification • Air Recovery

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Please send me, without obligation, full information on Dorex Air Recovery

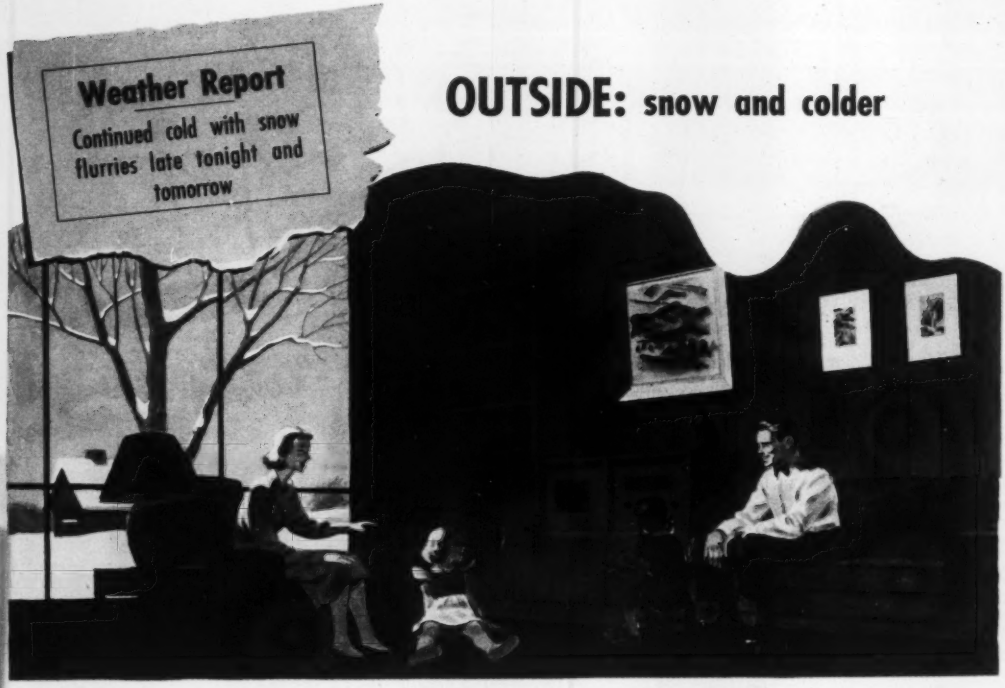
Name .....

Position .....

Company .....

Street .....

City ..... Zone ..... State .....



INSIDE: continued fair and warm

with SPANG CW PIPE

RADIANT HEATING INSTALLATIONS

Spang CW Pipe is performance-proved for closed hot water heating systems. For over half a century, the ease of fabrication—welding, bending, cutting, threading—has made Spang CW Pipe a favorite.

Spang CW is not only easy to form, but it's strong, too. The coefficient of expansion of Spang pipe is practically the same as that of concrete and plaster. Add the advantages of *low cost* and *long life*, and you'll see why Spang CW Pipe is in great demand.

Call on your friendly Spang CW Distributor the next time you need pipe, fittings, valves, fixtures and other piping materials. You can rely on him and the Spang CW Pipe he sells.

SPANG-CHALFANT

Division of The National Supply Company

GENERAL SALES OFFICES: Grant Bldg., Pittsburgh 30, Pa.

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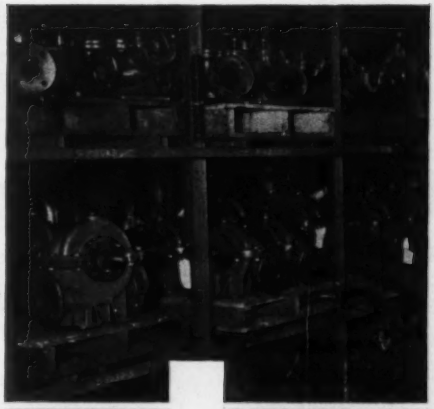
NEW DE LAVAL GS PUMPS

on their way to you in

2 WEEKS



From our shelf to your plant in two weeks! That's how fast you can get a standard centrifugal De Laval pump. We now have on hand GS pumps, motors and bedplates in sizes 2½", 3" and 4" ready for assembly and shipment. Capacities to 280 gpm, heads to 75 ft, at 1750 rpm. • Also available for immediate delivery are bare pumps in the same sizes with capacities to 400 gpm, heads to 230 ft, at 3500 rpm. We can assemble and ship these units within two weeks after receipt of the motor. • Want complete details quickly? Simply telephone or fill in the coupon and mail today.

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Dravo Corporation, Cleveland **HE 1-7500**
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50th DE LAVAL Anniversary

DE LAVAL STEAM TURBINE COMPANY
TRENTON 2, NEW JERSEY

DL 103

DE LAVAL STEAM TURBINE COMPANY, TRENTON 2, NEW JERSEY

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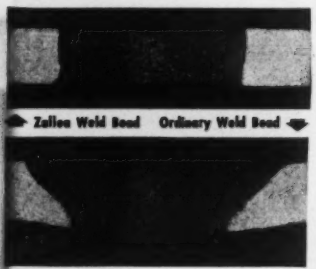
Zallea Expansion Joint News

PUBLISHED BY ZALLEA BROTHERS—WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS

Expansion Joint of the Month

ZALLEA CONTROLLED WELDING

For longest service life, it is essential that the corrugated bellows have a uniform thickness throughout. Only in Zallea Stainless Steel Flexible Connectors are you assured of this optimum condition because Zallea alone produces a longitudinal weld of the same thickness as the parent metal. Zallea metallurgists, after



analyzing the many known welding processes, adopted an exclusive variation of the Heliarc process and added a grain refining procedure to the finished weld. In hundreds of brutal flexing tests, not one failure occurred within 30 degrees of the weld line! More important was the fact that these bellows lasted 4 to 8 times longer than bellows having a shielded arc welding bead. Note the exclusive Zallea controlled welding technique as compared to the welding procedure used in other flexible connectors. When you want the best in flexible connectors, always specify Zallea...you'll find it pays!

. . . a brand new 4-page folder on *all* Zallea Expansion Joints. Send for your copy of Bulletin 351 today!

ZALLEA BROTHERS, 816 Locust Street, Wilmington 99, Delaware.

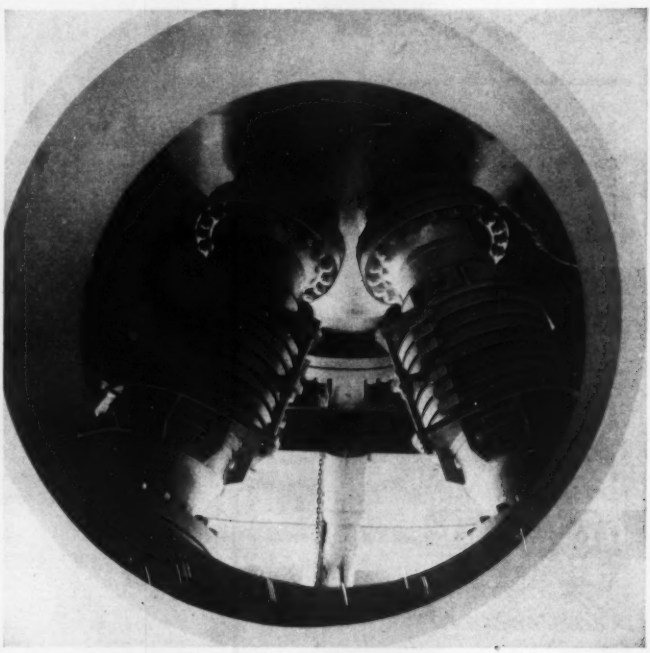
Large Refinery Selects Zallea

Big refinery operation requires only the best equipment . . . for assurance of dependable, long-lasting service. That's why Zallea Stainless Steel Expansion Joints were the logical choice for installation in the Houdry Process Cat Cracker at California Refining Company, Perth Amboy, N. J.

A total of 68 Zallea Joints are in service at this East Coast refinery, ranging in size from 30″ diameter downward, and from 11¾″ axial movement in combination with 4″ lateral movement any side of center line, down to lesser movements.

Shown below are two of the 68 Zallea Joints. These are 16″ diameter, modified Universal self-equalizing units, made of stainless steel and designed for an axial movement of 3⅞″ and a lateral movement of ¾″, either side of center line. These joints are installed on a line carrying hot bead catalyst to the engager, and operate at 20 psi at a temperature of 900° F.

Zallea Stainless Steel Expansion Joints are the first choice of refineries for dependable service. It's the high quality built into every Zallea Expansion Joint that makes them long-lasting—even under the severest service. Remember, there's no packing to deteriorate . . . no maintenance required. Just install them and forget them. There's a Zallea Expansion Joint for almost every requirement. Available in diameters from 3 inches to 30 feet for temperatures from sub-zero to 1600° F. . . . for pressures from vacuum to 300 psi in standard designs and up to 2000 psi in special designs.



Commemorating our 60th Anniversary

THE POWERS REGULATOR COMPANY

New Factory and General Office Building: **3400 Oakton Street, Skokie, Illinois**

World's Most Modern Factory Producing Automatic Temperature and Humidity Control

. . . to meet the greatly increased demand for POWERS products and to give you better controls, better deliveries and better values . . . these advantages are possible with our large new plant and modern production facilities. With an enlarged engineering and production staff, plus 60 years experience in heating, ventilating, air conditioning and process control, we believe we can be of greater service than ever before to our many friends who have contributed to our success.

WILLIAM PENN POWERS
. . . with his invention of the first all pneumatic system of temperature control and gradual acting vapor disc thermostat made an invaluable contribution to the modern science of heating, air conditioning and industrial process control.

POWERS CONTROL — TEMPERATURE AND HUMIDITY — 60th ANNIVERSARY 1891 1951

Offices in Over 50 Cities. See Your Phone Book.

Chicago 13, Ill., 3819 N. Ashland Avenue • New York 17, N. Y., 231 East 46th Street
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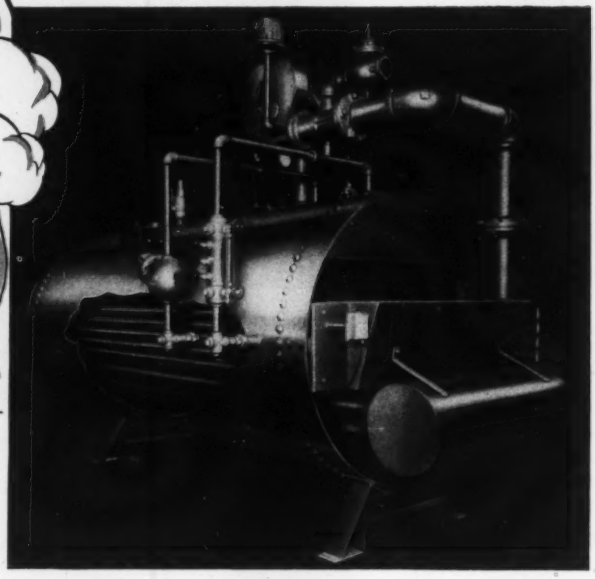
(a55)

Something to get steamed up about!



Sellers

IMMERSION STEAM BOILER

Once you know the unusual economy and dependable service available from a Sellers Immersion Steam Boiler you'll understand why this remarkable unit wins enthusiastic approval almost as fast as it generates steam!

The logic and simplicity of Sellers design . . . the efficiency of Sellers immersion firing principle will give you a new concept of boiler service. Whether you require steam for heating, for process purposes, or need a stand-by unit for peak loads, these amazing Sellers advantages merit investigation:

1. **Firing Tubes Are Completely Submerged**
   Every square foot of heating surface is effective water backed. **NO** water line corrosion.
2. **Maximum Heat Transfer**
   Hot expanding gases scour firing tubes free of dead gas film. Nothing between heat and water but metal.
3. **Scale Problems Minimized**
   Alternate expansion and contraction of firing tubes under intermittent firing cracks scale off surface of tubes.
4. **Maximum Safety**
   No separate enclosed combustion chamber. No explosion hazard. No brick linings to replace. No carbon traps.

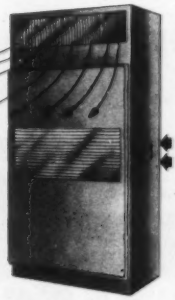
Sellers Immersion Steam Boilers are furnished in twelve sizes to meet all standard requirements. All are built to A.S.M.E. Power Codes. Get the complete Sellers story. Write for Bulletin No. 1206-C, today.

SELLERS ENGINEERING COMPANY
4876 North Clark St., Chicago 40, Illinois

Blast Heaters. Immersion Automatic Water Heaters. Vertical Steam Boilers. Air Heaters. Combustion Units. Industrial Gas Burners. Immersion Tank Heaters. Gas Combustion Equipment.

Now Garden-Fresh Air Everywhere with NO Mechanical Operating Costs!

RENOVAIR AIR DEODORIZER



RENOVAIR frees the air from even harsh paint and smoke odors, without perfume! And the RENOVAIR Gyrostatic Evaporator fits easily *inside* any air conditioning system or unit, and operates without an additional motor . . . reveals its presence only by the effect of garden-fresh air all the time! Simple to install . . . costs *nothing* to run!

MAINTAINS PLEASANT, PRODUCTIVE ATMOSPHERE EASILY, INEXPENSIVELY. Offensive odors can be costly . . . but RENOVAIR keeps air garden-fresh for only pennies a week! Clean, pleasant air by RENOVAIR will *attract* customers into stores and restaurants . . . keep employees happy and productive. Yet, RENOVAIR's foolproof Gyrostatic Evaporator installs easily, costs nothing to operate! RENOVAIR also performs perfectly from spray guns, fogging machines, or from the 12-ounce wick bottle for limited spaces.

NEUTRALIZES ODORS WITHOUT PERFUMING AIR — RENOVAIR uses non-toxic elements found in plant life — to neutralize indoor odors much the same as masses of green foliage freshen the air outdoors. *Contains no formaldehyde or chlorophyll* . . . will not burn, nor will it harm the sense of smell.

WHEREVER PEOPLE BREATHE RENOVAIR FILLS A NEED!

RESTAURANTS
STORES
WASHROOMS
HOSPITALS
SCHOOLS
THEATRES
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HOTELS & APARTMENTS
OFFICES
INDUSTRIAL PLANTS

FOR LIMITED NON-AIR CONDITIONED SPACES

Use this Handy RENOVAIR WICK TYPE DEODORIZER

JUST PULL UP THE WICK...

enjoy garden-fresh air without perfume

12-oz. bottle only **79¢**

Get complete details FREE in this handy RENOVAIR folder! Contains full description of how *you* can eliminate costly odor problems with inexpensive RENOVAIR and RENOVAIR's Gyrostatic Evaporator. Mail coupon *today!*

LIMITED DEALERSHIPS OPEN

Write for full details!

Boyle-Midway Inc., Correctair Division
22 E. 40th St., New York 16, N. Y.
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Boyle-Midway Inc., Correctair Division
22 E. 40th St., New York 16, N. Y.

Please send me your FREE RENOVAIR folder *at once!* I'm interested in further details about this amazing product.

Name_____

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City_____ Zone____ State_____

6 gpm

will pay for a new model

MARLEY

Aquatower

FOR INSTALLATION
INDOORS OR OUT

New Model 23

New Model 33

Models 23 and 33—newest in the complete Aquatower line—are specifically designed to save 90 per cent of the water charges on two to six-ton refrigeration installations. Even a 6 gpm service can use 250,000 gallons per month, so an Aquatower is a truly profitable investment in most cities. Aquatowers conform to all building code requirements. They are simple in design, foolproof in operation—distinct advantages to the average owner of a small installation.

Also producers of

VAIRFLO TOWERS
NATURAL DRAFT TOWERS
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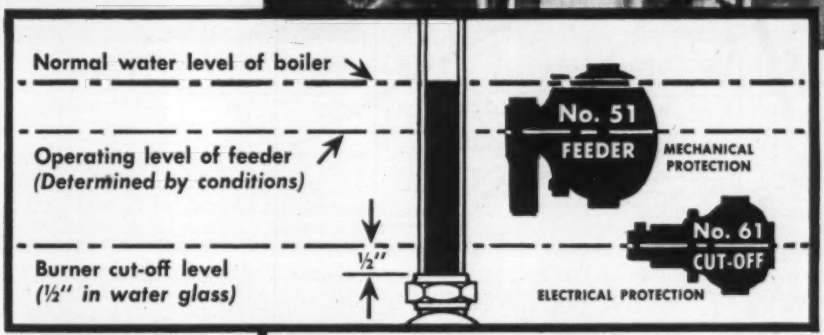
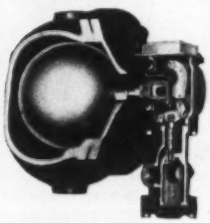
SPRAY NOZZLES

MARLEY

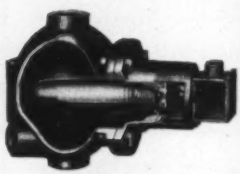
The Marley Company, Inc.
KANSAS CITY 15, KANSAS



The diagram shows the location of No. 51 Feeder and No. 61 Cut-off on the boiler illustrated, but can be applied to all cases. Since some water is returned to the boiler, the feeder is located to function below the normal water level. In all cases the cut-off switch is located to function when the water level drops to ½" in the gauge glass.



McDonnell No. 51 Boiler Water Feeder used in installation above. It is for boilers above 3000 sq. ft. capacity; maximum steam pressure, 35 lbs. Other types for boilers of all sizes; pressures up to 75 lbs.



McDonnell No. 61 Low Water Fuel Cut-off used in installation above. It is for boilers of any size; maximum steam pressure, 20 lbs. Other types for higher pressures.

Here is a simple answer to what some heating men consider a difficult problem. It's a simple and dependable way to maintain the water level in a boiler where all or most of the steam is used in process. Certainly, such boilers need the most adequate water level control that can be provided.

First notice the installation above. This boiler has *two* McDonnell controls. One is a No. 51 Boiler Water *Feeder;* the other, a No. 61 Low Water Fuel *Cut-off*. Why both a feeder and a cut-off? Why not a McDonnell feeder and cut-off combined?

The answer is that in process boilers—particularly the larger ones—we want to provide a greater differential between the opening of the feeder and stopping of the firing means than is possible when a feeder-cut-off combination is used.

The diagram explains this. We know that in a process boiler we need real water feeding capacity, so we position the feeder to start opening as soon as the water level falls a short distance below the normal level of the boiler. When the water level has fallen two inches below the operating level of the feeder the feed-valve will be wide open, delivering its maximum capacity to the boiler.

Now the feeder so located will maintain the water level under all normal conditions, so we want to give it "full charge" of the boiler and use the low water fuel cut-off only as a safeguard against an emergency condition. Therefore we set the fuel cut-off as low as safety permits—clear down where it will not stop the burner until the water falls to ½ inch in the water glass. In this installation the burner cut-off point is far enough below the opening point of the feeder, providing plenty of latitude for the feeder to do its job properly.

If a feeder-cut-off combination were used, the low water cut-off switch would stop the burner *before* the feeder had reached its maximum capacity. By using two controls—a feeder and a separate low water cut-off—this unnecessary and annoying interruption of operation is completely avoided.*

The controls used on this boiler are illustrated, but the same principle of wide operating differential can be provided for process boilers of varied sizes and pressures by combinations of other McDonnell feeders and cut-offs. Our engineering department will be glad to give recommendations covering specific conditions.

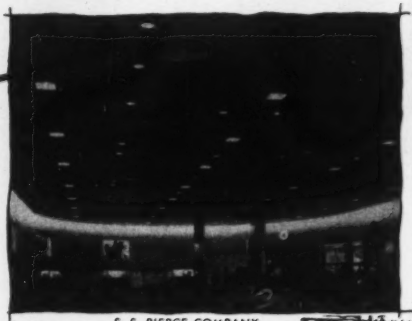
* This method should also be considered for all larger boilers where at times the condensate is diverted for blow-down, skimming the boiler, or where steam is used at times for process work. The added cost of using the two controls is insignificant in terms of larger boilers.

McDONNELL & MILLER, *Inc.*, 3500 N. Spaulding Avenue, Chicago 18, Illinois

Doing One Thing Well

McDONNELL *for Water Level Controls*

Aerofuse IN BOSTON



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In the shadow of Bunker Hill . . . Old North Church . . . and the many other historic landmarks here . . . busy Boston enjoys the comfort and convenience of modern air conditioning in its up-to-date commercial, industrial and institutional buildings.

As is the case in other cities from coast to coast, important air conditioning jobs in Boston are Aerofuse Diffuser jobs. Selected on the basis of efficient, dependable performance . . . and smart styling that blends architecturally with modern interiors . . . Aerofuse Diffusers meet the most exacting requirements at the *vital point of air delivery*, the point at which the success of an air conditioning installation is measured.

There's a complete Aerofuse line . . . a type and style to meet every job specification. For complete details, size selection information and engineering data, write for Catalog 104.

Other Typical Aerofuse Installations in the Boston Area

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Public Service Building

Veterans Hospital
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Junior High School
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TUTTLE & BAILEY inc
NEW BRITAIN, CONNECTICUT

ENGINEERED PRODUCTS FOR HEATING, AIR CONDITIONING AND VENTILATING

some fellows are just never content

You know the type . . . they keep fussing with, working on, and solving problems that seem impossible to most people.

Time was, when many folks in air conditioning thought that the pumps used to recirculate cooling water in air conditioning systems were pretty good. And when compared, pump for pump, this was true. Yet the fellows in the I-R laboratories weren't content. They figured that if they could make a *1½ H.P.* pump do the same work as an ordinary *2 H.P.* pump, they'd have something really special to offer. First cost would be lower, there would be a saving on space and weight and, more important, installations wouldn't be as expensive.

So I-R engineers worked on this idea; and when they informed us they had succeeded, we wanted proof. Then they told us about "an impeller of new hydraulic design," "extra heavy shafts designed for a maximum deflection of .001 inch," etc. But most important, they produced a line of Ingersoll-Rand MOTORPUMPS that proved to be tops in efficiency and reliability when compared size for size with *any* other type pump on air conditioning systems today!

This remarkably efficient I-R MOTORPUMP had a terrific impact on the air conditioning industry. For not only did it offer folks like yourself a way to recirculate cooling water with a smaller pump, but it was made readily available . . . right out of warehouses across the country. And these same warehouses offer service on all I-R MOTORPUMPS installed. Your nearest I-R distributor or representative has the facts and figures . . . call him in now, or write us for descriptive literature. Ingersoll-Rand Company, 11 Broadway, New York 4, New York.

Ingersoll-Rand

80 years of BIG PUMP know how packed into small pumps for air conditioning applications

MOTORPUMP

417-9

HOW DRAVO *Counterflo* HEATERS

*helped a large eastern railroad**

save $159,000.

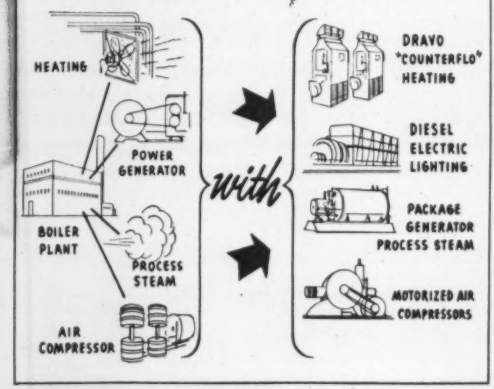
IN ONE YEAR

**Customer's name withheld on request.*

When a large eastern railroad dieselized its locomotive fleet, it not only reduced its road operating expenses, but found substantial savings in an improved method of providing heat, light and process steam for its reconverted shops.

By replacing the old steam power plant which had supplied heat, light, power and compressed air at a cost of $208,600 per year (not counting fuel transportation), the railroad now obtains its utilities for $48,676 per year at this installation. The savings offset the total investment in new equipment in ten months! Savings for the second year of operation amount to nearly $160,000.

HERE'S HOW...IT WAS DONE THIS RAILROAD REPLACED...



DRAVO HEATERS PLAY MAJOR PART IN THESE SAVINGS

These are the advantages the railroad gained through the use of Dravo "Counterflo" Heaters:

- . . . low initial cost . . . savings up to 60% on installation
- . . . concentration of heat at working level
- . . . 150 foot air throw . . . no duct work required
- . . . flexibility . . . units can be mounted in any position, floor, wall or ceiling
- . . . burn gas or oil . . . readily converted . . . low fuel consumption
- . . . automatic control . . . on-off or modulating controls
- . . . long service life, low maintenance . . . stainless steel combustion chamber
- . . . mobility: can be moved easily to any location

Versatile Dravo Heaters are used in nearly every type of industrial installation.

"Counterflo" Heaters are ideal for commercial and industrial use in foundries . . . warehouses . . . machine shops . . . stores . . . schools . . . churches . . . process industries . . . any many others. Why not look into the possibilities of Dravo Heaters for your heating and ventilating needs? Write today for Bulletin No. OP-526-687

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CUTS DAMAGE AND REPLACEMENT COSTS

NEW HEAVY-DUTY INDUSTRIAL GRILLE

CUSTOMED FOR FACTORY USE AND ABUSE

This grille especially designed for Atomic Energy Commission.

Contractors—
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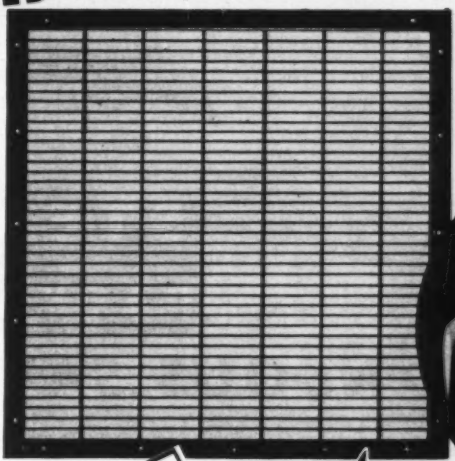
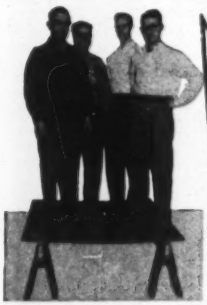
- 14 GAUGE STEEL BLADES
- VERTICAL SUPPORT BARS PLACED ON 6" CENTERS (14 GAUGE STEEL)
- STANDARD GRADE PRIMER COAT FINISH
- 16 GAUGE STEEL, EXTRA WIDE BORDER FOR EASY MOUNTING



At left—Grille face of LOWER WALL, INDUSTRIAL GRILLE. Note close spacing of extra-strength blades (⅜" centers).

Below—Close-up view of volume control section. Note famous solid section AIRFOIL LOUVERS. Each blade is individually adjustable. CONCEALED LOUVER SUPPORT eliminates mullions and butted construction.



At left— photo shows the 48" × 48" AIRFOIL INDUSTRIAL GRILLE supporting the combined weight of 4 Titus factory workers.

Air Foil
AIR CONDITIONING OUTLETS

Write for new, FREE complete catalog of Titus AIRFOIL air conditioning outlets—the most efficient grilles ever designed.

Free

More highly efficient . . . longer lasting . . . brand new . . . that's the AIRFOIL-DESIGNED, AIRFOIL-BUILT INDUSTRIAL GRILLE. Clean cut—compact—it is made in two sections . . . Grille Face and Volume Controller.

Rugged—braced for super-strength. The INDUSTRIAL GRILLE will stand up for years and years against the punishing knocks—jars—shocks—scratches and abuse that floor level grilles must take.

Volume Controller section features the famous solid section, streamlined AIRFOIL LOUVERS. Noise and turbulence are cut to a minimum. At the same time, perfect draft-free, air distribution is assured.

CHECK TYPE OF GRILLE ON WHICH INFORMATION IS DESIRED

- ☐ Air conditioning outlets
- ☐ Return air grilles and registers
- ☐ Volume controllers
- ☐ Perforated metal and ornamental grilles
- ☐ Door ventilators
- ☐ Special made-to-order grilles

TITUS MANUFACTURING CORP., WATERLOO, IOWA

- ☐ Rush information on Industrial Grilles.
- ☐ Send complete catalog.
- ☐ Send literature on above checked items.

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Patented metered air-oil injection provides perfect fuel combustion — cuts fuel costs.
Swirling flame produces higher speed of flame travel — more efficient heat transfer.
Dry-pan baffle insures low moisture steam.
Target ring reforms flame to insure complete combustion.
STEAM-PAK
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YORK POWER
GENERATOR
A PRODUCT OF YORK-SHIPLEY
STEAM
in a
PACKAGE

You Get TREMENDOUS SAVINGS!

Savings From Manufacturing Advantages:

Steam-Pak Generators are factory engineered, built and pre-tested—manufactured on production line basis for quality and lowest possible cost.

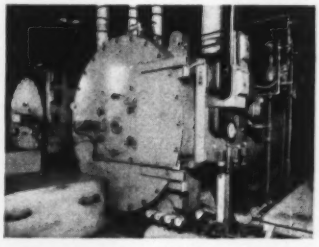
Savings From Installation Advantages:

Mechanical draft eliminates expensive chimney—packaged unit requires no special foundation—flexibility permits multiple installation—installation costs are cut to a minimum.

Savings From Operating Advantages:

Automatic controls eliminate high labor costs—faster starting with faster steam saves costly waiting time and efficient firing cuts fuel costs.

Thousands of users are evidence of the tremendous savings found with Steam-Pak Generators. They are built in sizes from 15 h.p. up, for low or high pressure, steam or hot water, for light or heavy oil, combination gas and oil, or straight gas.



Multiple installations such as this one, costing about $10,000, *save an average of* $1,000 *per month in fuel and labor alone.*

YORK SHIPLEY

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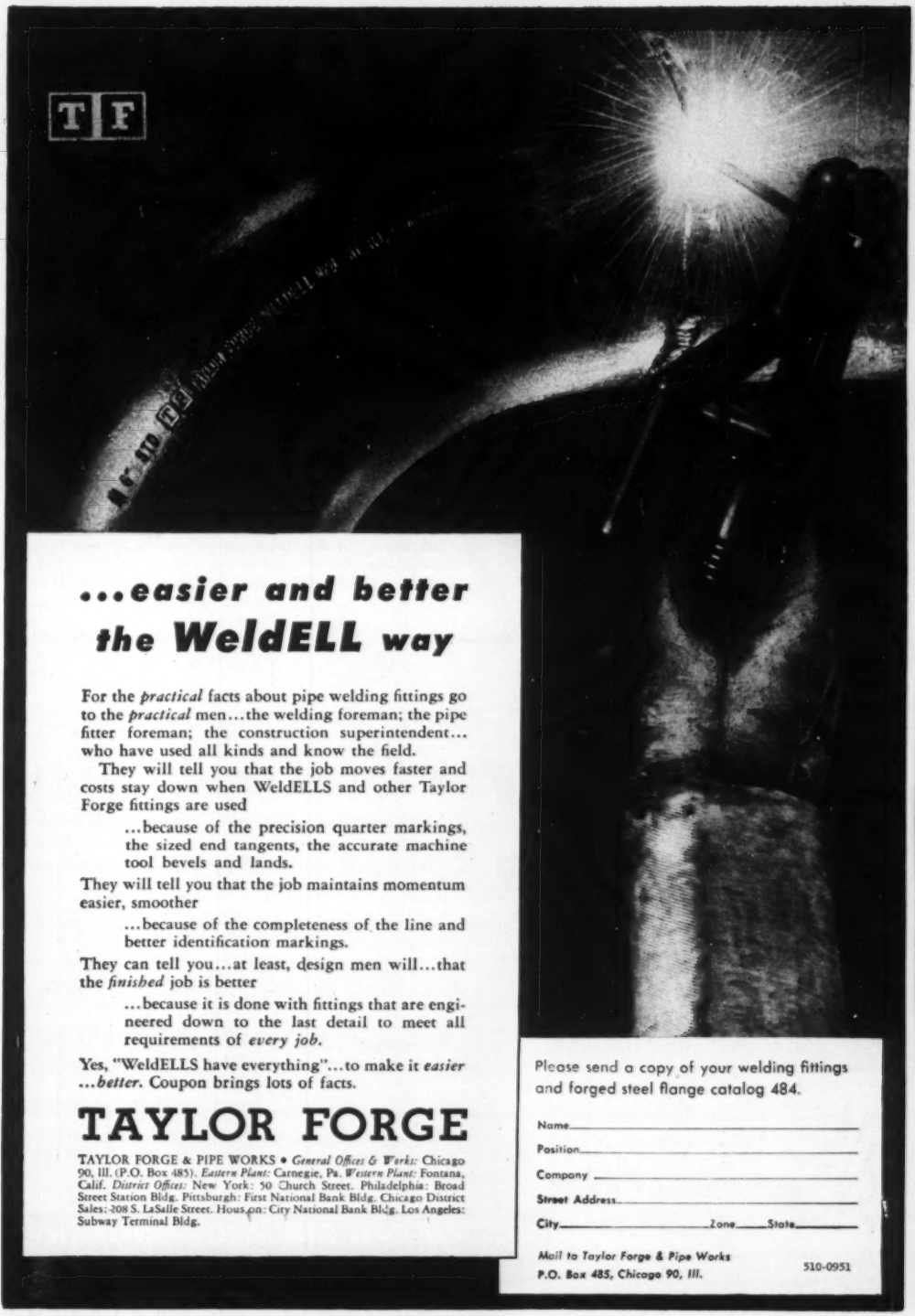
Industrial Division

INDUSTRIAL DIVISION YORK POWER

YORK HEAT RESIDENTIAL DIVISION

Steam-Pak Generators · Vertical Boilers · Rotary Oil Burners · Conversion Oil Burners · Conversion Gas Burners · Water Heaters · Winter Air Conditioners · Tubeless Boiler Units



...easier and better the WeldELL way

For the *practical* facts about pipe welding fittings go to the *practical* men...the welding foreman; the pipe fitter foreman; the construction superintendent... who have used all kinds and know the field.

They will tell you that the job moves faster and costs stay down when WeldELLS and other Taylor Forge fittings are used

...because of the precision quarter markings, the sized end tangents, the accurate machine tool bevels and lands.

They will tell you that the job maintains momentum easier, smoother

...because of the completeness of the line and better identification markings.

They can tell you...at least, design men will...that the *finished* job is better

...because it is done with fittings that are engineered down to the last detail to meet all requirements of *every job*.

Yes, "WeldELLS have everything"...to make it *easier ...better*. Coupon brings lots of facts.

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Please send a copy of your welding fittings and forged steel flange catalog 484.

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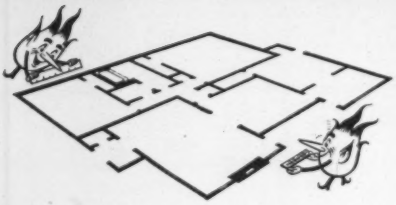
THREE SIMPLE STEPS

TO DESIGN A VULCAN RADI-VECTOR SYSTEM

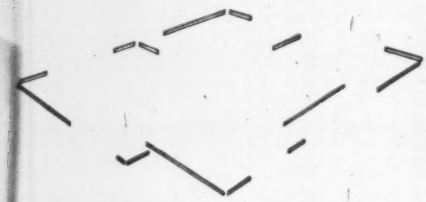


1

CALCULATE HEAT LOSSES

Vulcan Radi-Vector does not require any special methods for calculating heat loss. Simply follow standard procedures recommended by the I=B=R* Installation Guides, ASH & VE Guide or other standard reference books.

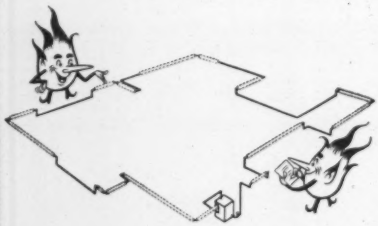
* Reg. U. S. Pat. Off.



2

SELECT THE RADI-VECTOR

The flexibility of the Vulcan line allows accurate matching of Radi-Vector to the load and space available. All radiation for a particular building can be easily selected from one simple table in Vulcan Catalog #53A. Vulcan ratings are approved by the Institute of Boiler and Radiator Manufacturers.



3

DESIGN THE PIPING

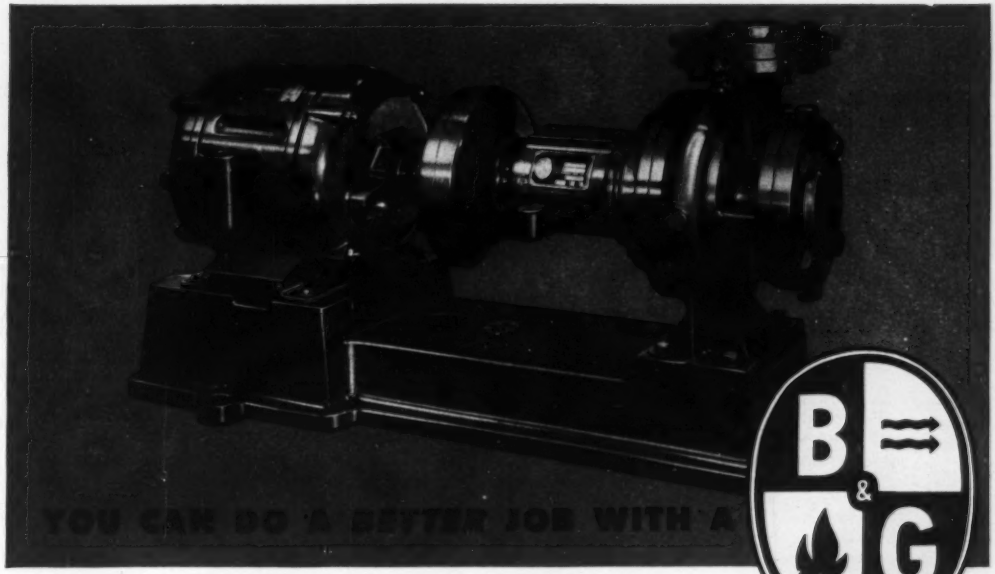
Vulcan piping tables allow for easy designing of any type hot water or steam system. Data is expressed in the easiest form for direct use with Radi-Vector.

Contact your nearest jobber or Vulcan Representative or write direct for Vulcan catalog #53A. It gives all the necessary information for designing and installing a small simple unit or a deluxe Vulcan Radi-Vector system.

Made in Canada, under trade name of Heal Radiation, by the Vapor Car Heating Co. of Montreal.

THE VULCAN RADIATOR COMPANY
26 FRANCIS AVE. HARTFORD, CONN.

OVER A QUARTER CENTURY OF FIN-TUBE RADIATION



For your larger forced hot water heating installations, *this is the pump!* It's the big brother of the famous B & G Booster, with all of the basic features of this biggest-selling circulator. The water-tight seal, for example, polished steel shaft with integral thrust collar, extra-long bronze bearings and oil lubrication. Like the Booster, it can be serviced without removing from the line.

Obviously, the B & G Universal is *not* just another centrifugal pump. It is engineered in every detail—including a specially designed motor—to assure that all-important quality of *quietness!*

With heads to 78 feet and capacities to 1,200 GPM, the B & G Universal Pump is suitable for application in garden apartments, industrial plants, institutions and commercial buildings. You can install it with complete confidence in its efficiency and all-around dependability.

Complete information is given in the B & G Catalog —send for your copy.

Hydro-Flo UNIVERSAL PUMP

An application of B&G Universal Pumps in a plant where hot water is used for space heating, service water heating and process work.

BELL & GOSSETT COMPANY

Dept. CE-5, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada

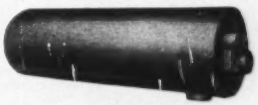
FORCED HOT WATER HEATING EQUIPMENT . . . CENTRIFUGAL PUMPS . . .
WATER HEATERS . . . HEAT EXCHANGERS . . . REFRIGERATION EQUIPMENT

B & G Hydro-Flo Products protect your most valuable asset — customer satisfaction

B & G FLO-CONTROL VALVE

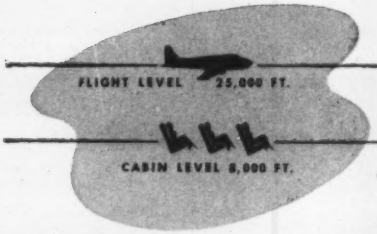
B & G MONOFLO FITTING

B & G RELIEF VALVE (ASME)



B & G INDIRECT WATER HEATER

*REG. U. S. PAT. OFF.



In modern air-liners you breathe comfortably at altitudes of 25,000 ft., because your cabin is "Pressurized" — air pressure inside the plane is kept at or near normal sea level pressure.

Boilers, too, "breathe" easier when their combustion air is "pressurized" using forced draft

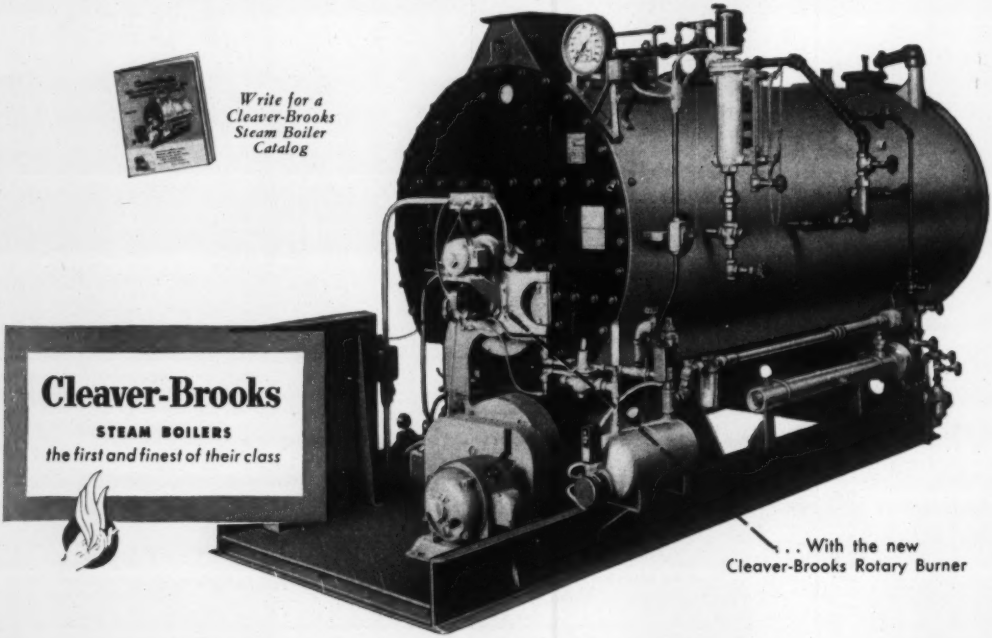
Cleaver-Brooks experience with thousands of steam boilers, of the self-contained type, has conclusively proven these operating advantages of forced draft:

- — because atmospheric boiler-room air is constant in temperature and therefore in density, the weight of air delivered for combustion by a forced draft fan is also constant and always gives proper air-fuel ratio (CO_2) resulting in maximum efficiency and freedom from combustion problems.
- — the electrical load, or power requirement, of a forced draft fan is at a minimum, because the fan handles a lesser volume of air.
- — low fan maintenance and longer fan life with forced draft fans since they operate with cool, clean boiler room air — no problems with high bearing temperatures and corrosion.
- — air is under pressure in the combustion chamber of a forced draft boiler, with no possibility of "diluting" air entering the chamber. Maximum boiler efficiencies are always attained when head plates and casings are tight.
- — lower initial fan cost, better space arrangement, and better appearance are gained because forced draft fans are considerably smaller.
- — casings for forced draft fans are cool — require no insulation — contribute to safer operation and cooler boiler rooms.

Forced draft is one of many reasons why you get a greater return from your investment in a Cleaver-Brooks boiler — a boiler of foremost quality in every detail and with many immediate and long-range cost-saving features. Cleaver-Brooks self-contained boilers are available for oil, gas, combination oil and gas firing — 15 to 500 hp., 15 to 250 lb. p.s.i.

CLEAVER-BROOKS COMPANY
367 E. Keefe Ave., Milwaukee 12, Wis.

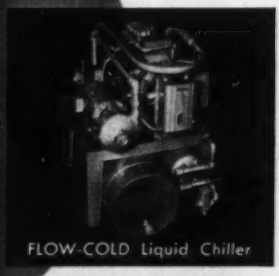
Write for a Cleaver-Brooks Steam Boiler Catalog



the huge industrial market is now open to you with

FLOW COLD*

the compact, packaged liquid chiller



FLOW-COLD Liquid Chiller

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ACME Convector
(Remote Room Air Conditioner)

Suspended Air Handling Unit

Finned Coils

Tremendous production increases reported by industrial firms maintaining temperatures of coolants in broaching, honing, boring, grinding and finishing operations *with Flow-Cold**. Uniform production and maintenance of closer tolerances result from exact temperature control . . . Plating and anodizing production speeded by controlling solution temperatures with Flow-Cold . . . Steel and aluminum welding production increased through Flow-Cold's cooling action . . . Greater uniformity of welds, fewer rejects.

COMMERCIALLY. . . Here is your answer for central drinking water systems; photographic solution cooling . . . jacket cooling for bakeries, and many other applications.

AIR CONDITIONING . . . Flow-Cold offers you in a compact packaged unit, the ultimate in air conditioning. Home owners, offices, hotels and motels may now enjoy the same *personalized* air conditioning formerly available on large hospital, hotel and office building installations.

Assure your customers a balanced, efficient system with carefully engineered, matching Acme products; Flow-Cold Cooling Towers, Convectors (remote room air conditioners), Finned Coils and Air Handling Units. Over thirty years of experience and top engineering are behind every Acme product. Consult your Flow-Cold wholesaler, Acme's local representative or the factory for further information.

**TRADE MARK*

ACME PRODUCTS

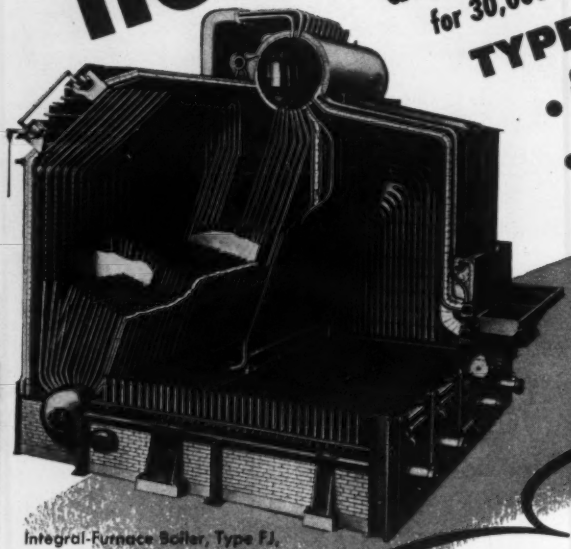
Acme INDUSTRIES, INC.
Dept. HP
JACKSON, MICHIGAN U.S.A.

now

an integral-furnace boiler for 30,000–70,000 lb. steam per hr.

TYPE FJ SAVES:

- fuel
- maintenance
- space



Integral-Furnace Boiler, Type FJ, arranged for stoker firing.

Another Example of B&W Engineering for Economy

The Integral-Furnace Boiler, Type FJ is a recent addition to B&W's line of completely coordinated furnace-boiler steam-generators. It makes available a compact, highly efficient installation to answer all process, heating, or power requirements from 30,000 to 70,000 lb. per hr.

Complete fuel-flexibility — coal, oil, or gas, with a choice of alternative firing arrangements — protects the investor against radical changes in fuel prices or conditions of supply. This unit burns a wide variety of fuels — including those of inferior grades and low-temperature ash-fusion characteristics — with high heat-rate efficiency, low maintenance, and minimum stack emission.

Unusually wide leeway in water-level and allowable boiler-water concentration is provided by the large drum and efficient cyclone steam separation system . . . which also contribute to ease in meeting sudden and severe load swings.

This unit incorporates all the advantages of Integral-Furnace design, which has proved so successful since its introduction by B&W in 1933. The popular Integral-Furnace "Family" now includes Types FH, FL, FJ, FF, and Shop-Assembled FM Units — spanning a range of steam-capacity now available from 2,800 to 350,000 lb. per hr.

Complete details of construction and operating advantages of the Integral-Furnace Boiler, Type FJ are included in new Bulletin G-70, available upon request from the Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

BABCOCK & WILCOX

G-542

THE EDITOR'S PAGES

• IT IS WITH PLEASURE that we show a new name in the membership of HPAC's board of consulting and contributing editors, as listed on page 5. It is that of G. W. Hauck, who is manager of engineering sales, Crane Co., and who has written numerous articles which have appeared in our pages over a period of some years. His most recent HPAC article was published last month, and it showed, by an example, how the installation and maintenance facilities available on a project influence the proper selection of the types of pipe joints to be used. We look forward — and we know HPAC's readers do, as well — to Mr. Hauck's next contribution . . . . . Listing sheets to be mailed to the manufacturers of equipment used in heating, piping, and air conditioning installations in industrial and big buildings are now being prepared for mailing early next month. The Directory Section, to be published in next January's issue of HPAC, is compiled from these sheets as returned to us by the respective manufacturers. Compiling the sheets — which cover a most comprehensive listing of products — is quite a task; so is the job of checking them. The result is, however, well worth the effort involved — a complete and accurate listing of heating, piping, and air conditioning equipment classified by product; a trade name section; and a street address section, all designed for your use throughout next year.

PIPING PIX SHOW CONTRACTOR'S BIZ

ONE OF THIS MONTH'S articles describes a rather unusual project — a 16 mm motion picture, in sound and color, produced by the Phillips, Getschow Co., contractors, showing the construction of a large power station piping system. Unfortunately, black and white reproductions of shots taken from the color film itself don't do full justice to the pictures, but we think that those shown in our article, with the accompanying text, will give you a very good idea of what the film covers and some of the technical information which it presents.

We don't know what the investment in time and money to produce this film was, but it must have been considerable. The picture does a beautiful job of explaining the skill, experience, facilities and equipment which are needed in the installation of one of today's piping projects — and which are the contractor's stock in trade. We recommend reading of the article in this issue — and if you get a chance to see the film itself, we recommend that too.

(*Note*: We tried — unsuccessfully — to write a title for this item in the style of *Variety*, trade paper of the entertainment world. Forgive our attempt).

DUAL ROLE FOR A.C. IN FRUIT STORES

A "SECONDARY USE" for air conditioning has been adopted by the Smilen Brothers, Inc., chain of fruit stores in New York City. Smilen Brothers claims the distinction of being the first company in the country to air condition fruit stores, and in many of them the open-front feature common to this type of store has been preserved.

At first, air conditioning for Smilen Brothers stores was strictly for customer comfort, good will, employee morale and efficiency, and other well-known advantages which air conditioning brings.

Recently, however, the role of the air conditioning units has been doubled, says the Typhoon Air Conditioning Co., Inc. Instead of picking up all the produce at the end of the day from the racks and placing it in cold storage for the night, the air conditioning equipment is left running throughout the night and the merchandise left in place on the racks.

Of course this calls for a greater capacity in equipment, but since doors and windows are closed at night, the temperature can be kept between 58 and 62 deg with only slightly over-sized equipment. For example, two 5 ton units will perform the dual job where a 7½ ton unit would be needed for comfort cooling alone. Most Smilen stores are roughly identical, with a 15 by 40 ft selling area and a 15 by 40 ft stockroom. The selling area is air conditioned by one unit, in most cases a 5 ton, and the stockroom by another unit of the same size which also acts as a booster conditioner for the unit which cools the selling area.

By using two 5 ton air conditioners, a certain amount of flexibility is gained. On spring and fall days when the heat is not excessive, one unit alone will often suffice. Furthermore, in case one of the air conditioners should fail to function for any reason, the other unit will continue to cool the store until repairs are made.

TWO 5 TON CONDITIONERS in one of the Smilen fruit stores. Unit at left serves front selling space, and the other cools the stockroom and acts as booster for front

REPORTS SALES, EARNINGS, TAXES

COMPLETED SALES of $45,730,837, an increase of 22 percent, were reported by York Corp. for the nine months ended June 30. New business booked for the same period was $50,123,411, up 44 percent. Earnings after taxes amounted to $2,259,115, an increase of 21 percent. Income taxes amounting to $2,661,180 were in excess of earnings after taxes and were 100 percent greater than in the similar period a year ago.

LEAK DETECTOR CUTS VALVE REJECTS

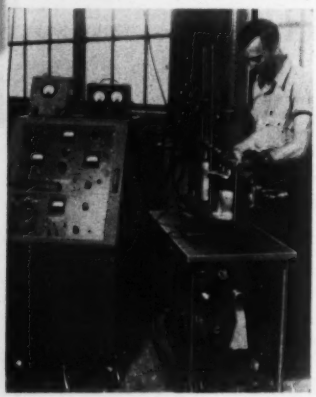
DEFECTIVE VALVES for nuclear reactors and atomic piles have been cut 25 percent by the use of a leak detector at a valve manufacturer's plant, according to the General Electric Co.

Large orders for leakproof valves for atomic apparatus required the manufacturer to change from its air pressure testing method, which failed to indicate all leaks. Also, when a leaky valve was discovered, the air pressure method did not show the exact location of the leak.

With the new testing method, using the leak detector and helium tracer, it is possible to detect faulty foundry and welding practice and correct it.

In testing, the valve is sealed off on a test stand and connected through the leak detector to a vacuum pump. The operator checks for leaks by moving a capillary tube which emits the helium tracer over the entire surface of the valve. If a leak is present in the valve, helium will be drawn through it into the valve, and will give an indication on the detector's meter. In this way, minute leaks are accurately located in the valves and defects can be corrected.

DEFECTIVE VALVES cut 25 percent by using leak detector



SPEEDS REPAIR OF FLOODED EQUIPMENT

TO DRY OUT MOTORS and transformers, and to bake on new insulating varnish when needed, a special emergency oven 36 ft long, 12 ft high and 16 ft wide was built at the emergency repair depot set up by the Westinghouse Electric Corp. in its huge jet engine plant to put equipment damaged by the Missouri and Kaw River floods back in shape for service. The oven is heated to 240 deg by steam pipes and electrical strip heaters.

C. G. Roush, manager of the Westinghouse Kansas City office, is coordinating the company's emergency repair program for the city. Repair specialists were brought into Kansas City from Boston, Atlanta, Philadelphia, Denver, Pittsburgh, Chicago, Detroit, Cincinnati, Houston, St. Louis, and Charlotte to aid the local force and the staff of the jet engine plant during the emergency operations.

Virtually every piece of electrical apparatus entering the plant must be completely disassembled before repair and testing can be undertaken.

NPA INQUIRY CENTER AIDS BUSINESSMEN

EMPHASIZING THAT most business inquiries can be answered and most business problems solved in the various field offices of the National Production Authority, U. S. Department of Commerce, the NPA called attention last month to services offered by its newly established Business Inquiry Center, Washington, D. C.

For businessmen who must make trips to Washington because they are unable to work out their defense problems with the Commerce Department field office at home, the Business Inquiry Center should be the first point of contact in Washington, says the NPA.

Located in the main floor lobby of the Old GAO Building, at Fourth and G Sts., NW, in downtown Washington, the new center is directly across the street from virtually all NPA and DPA offices in the city.

It is open daily, except Saturday and Sunday, from 8:30 a.m. to 5 p.m.

The telephone number for the Business Inquiry Center is STerling 5200, with the following extension numbers for the several units: reception — 4411; distribution — 4239; business inquiry — 5280, 5310 and 5279.

SUN SHADES CUT COOLING LOADS

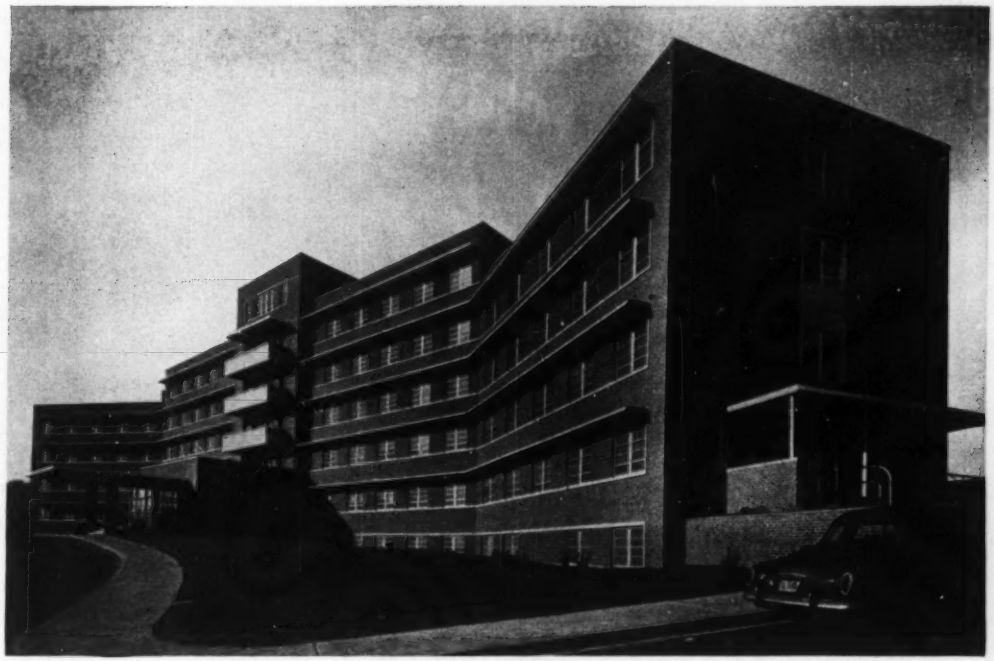
HOW AIR CONDITIONING loads are reduced by aluminum sun shades is the subject of a short article in the current issue of the Aluminum Association's quarterly bulletin.

One example is a 17 story bank and office building designed for the First National Bank of Arizona, in Phoenix, which will utilize a "floating screen" of fixed aluminum louvers to shield the south side of the building. Resembling a "gigantic glittering venetian blind", the 180 ft screen is to be suspended a few feet from the building's facade and will be designed so as not to obscure the view from the office windows.

A number of articles published in HPAC have described the use of vertical fins and other methods of reducing sun loads.

"QUOTE"

"I am not gifted in repartee but rather in the companion art of departee, wherein one thinks of the witty or apt reply two hours later when he is home in bed."—*Bishop Benjamin D. Dagwell, at the semi-annual banquet of the American Society of Heating and Ventilating Engineers, at Portland, Ore.*



East Tennessee Tuberculosis Hospital, Knoxville, Tenn. Architects and Engineers: Baumann and Baumann; Will W. Griffin and Shi G. Goodwyne, Associates. Heating Contractors: John F. Humphrey Company, Knoxville. Medical Consultants: Dr. R. H. Hutcheson, Commissioner of Public Health and Secretary of the Tennessee TB Commission, and Dr. W. W. Hubbard, Director of Hospital Service for the State of Tennessee.

Four-Zone Steam Heating For Modern

180-BED TB HOSPITAL

Heating specifications for the new East Tennessee TB Hospital stated: *"There shall be continuous flow of steam to the system with full or fractional heating of radiators at all times when heat is on".*

A 4-zone Webster Moderator System of Steam Heating meets this specification, supplying steam according to need for nursing floors, service and treatment units, operating rooms and laboratories.

The new Hospital is an important unit in the Tennessee plan, conceived by Governor Browning in 1937, to coordinate new and existing state-owned tuberculosis hospitals.

In addition to supplying 180 additional beds, the new building provides for surgical and laboratory work for all TB institutions in the area north of Knoxville.

Other Webster heating products used include Type "WI" Radiation; Webster Radiator and Drip Traps throughout, three Webster-Nesbitt Unit Heaters with Series 45 Unit Heater Controls; Webster '78' Process Steam Traps for medium and high pressure service, including laundry equipment; a Webster Oil Separator and Grease Trap for the Feed Water Heater; Webster Steam Separator, and Webster Vacuum Breakers for hot water generators.

The new Hospital is proving in operation the soundness of the designers' conception. Want some information on Webster's money saving ideas for hospital heating? Call in the Webster Representative or write us.

Address Dept. HP-9

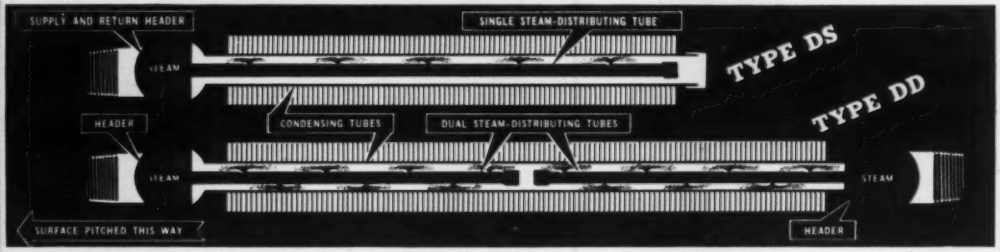
WARREN WEBSTER & COMPANY
Camden 5, N. J. Representatives in Principal U. S. Cities
In Canada, Darling Brothers, Limited, Montreal

WEBSTER
MODERATOR
SYSTEM
OF STEAM HEATING
"Controlled by the weather"

NESBITT Positive Freeze Protection

results from (1) Uniform Steam Distribution, and (2) Condensate always exposed to entering Steam

NESBITT SERIES D SURFACE IS MADE IN TWO TYPES:



TYPE DS SURFACE: Single supply header; single steam-distributing tube inside each condensing tube, for normal heating and ventilating applications. For installations requiring more uniform discharge temperatures, Type DS Surface with DUAL steam-distributing tubes in finned lengths up to six feet.

TYPE DD SURFACE: Two supply headers (one at each end of the surface section); DUAL steam-distributing tubes inside each condensing tube; steam conducted from the header at each end toward center. Assures uniform discharge temperatures over finned lengths from 78" to ten feet.

How STIFF are the surface requirements in that low-pressure, valve-controlled job of yours? Must you have *strictly uniform discharge temperatures*, regardless of coil length? Then specify Nesbitt Series D Heating Surface with DUAL steam-distribution tubes. Or do you have *less exacting requirements*, but still need acceptable distribution, regardless of coil length? Then specify Nesbitt Series D Heating Surface with SINGLE steam-distributing tubes. All Nesbitt Series D heating coils are *freeze-proof* without the aid of pre-heaters because of the steam-distributing tube feature, developed by Nesbitt. Play safe: say *Nesbitt*.

FREE: Publication 247, Nesbitt Series D Heating Surface; Publication 248, Nesbitt Series H Surface, for Heating, Ventilating, Drying; Publication 246, Nesbitt Series W (Water) Surface, for Air Cooling, Dehumidifying, Heating.

OFFICES IN ALL PRINCIPAL CITIES—LIST UPON REQUEST

"Open for Discussion"

• How about expressing your views on one of the articles in this month's issue of HPAC, for publication in these pages? Your comments on a controversial point, or additional information based on your experience, would be interesting and helpful to others. Or perhaps you'd like to say a little on some other matter of importance to plant engineers, building engineers, operating and maintenance men, heating, piping and air conditioning engineers or contractors? We follow here each month the practice at engineering society meetings of providing an "open for discussion" period. You are cordially invited to participate. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

HIGH TEMPERATURE PROCESS PIPING

The article in the May HPAC on high temperature liquid process piping systems is highly interesting. The author states that tetracresyl silicate is liquid from 1 F up to 825 F, which gives the impression that it can be used with this temperature range. He further indicates that it can be utilized in the temperature range between 500 F and 700 F.

According to my knowledge, tetracresyl silicate has been developed in this country, but the use of pure tetracresyl silicate has been abandoned in favor of mixing it with different aryl silicates so as to form a solution with more favorable heat transfer properties. The freezing point has been considerably lowered without affecting the decomposition point. We have some doubt that pure tetracresyl silicate can operate at temperatures of 700 to 825 F for long periods.

The London plant described in the article operates at a temperature of 350 F and therefore cannot serve as a reference for describing the behavior of the liquid at the higher temperatures.

Our organization designs installations for this temperature range, and we have used fluids which are in the liquid phase up to 800 F and which can be guaranteed for a long operational life at temperatures up to 750 F. Above 800 F temperature, salts in liquid form are used. These liquids offer many advantages as high temperature heat carriers.

One of the most important factors in determining the applicability of a liquid as a heat carrier is the length of time it can be used at the maximum operation temperature without deteriorating. Usually, 3000 to 4000 hr operation at this maximum temperature is required, but often much longer operation time is needed because replacement of the liquid is not only expensive but cumbersome.

A considerable number of liquids which can be used as heat carriers in the temperature range up to 350 F have been developed. Most of them offer attractive properties and are available at lower prices than is tetracresyl silicate.—Paul L. Geiringer, Chief Engineer, American Hydrotherm Corp.

WHAT IS A DRAFT?

The dictionary defines "draft" as pertaining to various categories of expressions and subjects, such as — an outline or sketch; a bill of exchange; an order for money; a plan of recruiting soldiers by conscription; an act of drawing a load by beasts; a quantity of fish caught at one draw of the net; the depth of water a vessel draws or to which she sinks; a drink; to sketch out; and — along with these other definitions — a current of air.

The word "draft", when used in connection with heating, ventilation and air conditioning, therefore refers to the matter of air velocity or air currents. The conventional usage of the word is generally accepted as meaning an objectionable air velocity, affecting the comfort of the individual directly in the path or stream of the air movement. As a matter of fact, the same air velocity that produces, at some fixed temperature and relative humidity, physical discomfort to a person may be conducive to enhancing the comfort of others, in the same path of air, and be adjudged pleasant and invigorating.

To understand better the seeming ambiguity of the above statement, we can refer to the chapter on physiological principles in the ASHVE's Heating, Ventilating, Air Conditioning Guide, which pertains to the thermal interchanges between the body and its environment.

The body temperature depends upon the balance between heat production and heat loss.

The heat resulting from oxidation in the body (metabolism) maintains the body temperature well above that of the surrounding air in a cool or cold environment.

Heat is constantly lost from the body by radiation, convection and evaporation. Since under ordinary conditions the body temperature is maintained at its normal level of about 98.6 F, the heat production must be balanced by an equal heat loss. Whenever this function is in true balance, the person is without stress and is said to be comfortable.

The average well person, in sedentary occupation, has an average total metabolic rate of 380 Btu per hr. Of this, 200 Btu is sensible heat and 180 Btu is latent heat, all to be balanced by the surrounding air. If this person is subjected to an environment in summer having an 80 F temperature and 50 percent relative humidity, with an air movement of 25 fpm, he should be quite comfortable — although quite uncomfortable if the surrounding air velocity were increased to 100 fpm.

In the same environmental condition of temperature and relative humidity, the average person doing

strenuous work requiring maximum physical exertion and generating a metabolic rate of say from 800 to 1500 Btu per hr, would be reasonably more comfortable with the surrounding air velocity at 100 rather than at 25 fpm.

Since the normal rate of heat production (metabolism) by persons varies widely and is dependent upon many factors, such as state of health, clothing worn, occupational efforts demanded and other factors, as well as environmental conditions, it would seem to be difficult to lay down one hard and fast rule or definition of what constitutes an "objectionable draft".

For the want of a better definition, my thinking is along the line that any air velocity that tends to produce body stress, or upsets and accelerates the normal metabolic rate to compensate for heat loss, thus producing a chilling effect to the person—such air velocity could reasonably be considered as an objectionable draft. The objectionable effect would be further enhanced if only a part of the body, such as the head or feet, were subjected to the higher air velocity.—E. P. HECKEL, E. P. Heckel & Associates, Consulting Engineers. Members of HPAC's Board of Consulting and Contributing Editors.

VENTILATION OF CIVIL DEFENSE SHELTERS

I BELIEVE THAT Warren Viessman, in his article on Protective Shelters in Modern Warfare, published in the March and April issues, has brought to our attention a number of very important facts to be considered in the design of protective structures. We need all the ideas and information we can get on this subject.

In reply to Mr. Viessman's comments in the June HPAC, the recommendations made in my paper on ventilation of survival areas (published in May) for a design factor of 500 lb per sq ft for shelter areas, in factories, etc., were made in conformance with the recommendations in the booklet Damage from Atomic Explosion and Design of Protective Structures (U. S. Government Printing Office). This publication indicates that this is advisable "to provide reasonable safety against blast and radiation injury at a distance of one-half mile from ground zero." There can, of course, be no hard and fast rule in this matter. Each situation will require separate analysis and the balancing of a number of variables.

This same principle would govern whether to ventilate or not to ventilate any survival area. The U. S. Navy formula given in my paper will indicate that in many cases, survival areas may be occupied without air change or air treatment for periods sufficiently long to be safe against attack in radiological warfare. I personally doubt the probability of bacterial weapons being used in conjunction with an atomic bomb attack, as several of the forces developed by the explosion would be very effective in destroying airborne organisms.

However, even in areas occupied by a considerable number of people, I believe it would be safer and much less expensive to arrange the ventilation system so that in case of an air raid warning, it could be shut down or the dampers adjusted to secure complete recirculation of the air within the structure. Devices are available which would take care of this automatically if abnormal concentrations of radiological poisons were present in the air.

My studies in this field have led me to feel very definitely that electrostatic precipitation or ultraviolet radiation, alone or in series, would not give adequate protection against some of the organisms which might be used in biological warfare. This also applies to the glycols, due to the difficulty in maintaining the precise humidity levels necessary for maximum efficiency.

Mr. Viessman points out that it is necessary to protect paper filters against heat and blast. I believe that it should also be emphasized that *all* types of filters, fans, humidifiers, ducts and (in fact) any and all equipment not adequately protected would probably be damaged or destroyed by the shock waves and the accompanying air blast.—HOWARD C. MURPHY, Consulting Engineer. Member of HPAC's Board of Consulting and Contributing Editors.

HOW TO TEST FANS FOR NOISE LEVEL

I SHOULD LIKE to comment further on the matter of testing fans for their noise level, and particularly in regard to R. A. Gerlitz' statements in reply to my previous remarks published in "Open for Discussion" in the August HPAC.

Mr. Gerlitz evidently thinks that the objective of the proposed 6 in. distance in the Industrial Unit Heater Association's proposed sound rating code is to get a highly accurate decibel rating, whereas the real reason is to obtain a fair method of rating and a representation that will enable the architect or professional engineer to evaluate what is being offered and enable him to reduce the so-called "annoyance" by soundproofing if necessary.

Under existing codes, a unit could be rated 40 decibels in one laboratory, 50 db in another, and the same unit could be a howling nuisance when installed in a gym. Rating by acoustic power output would allow the user to anticipate installed conditions. However, such a rating should be accompanied by a rating in phons which takes into consideration frequency.

Since machines of good design minimize the possibility of highly localized sound pressures, it is assumed that the microphone will be used as a design tool before the unit is produced for rating.

Symbolic ratings must be considered as functions of the manufacturer's laboratory and personnel and should be avoided.

It behooves engineers to educate the public regarding noise.

The writer has conferred with the personnel of many reliable laboratories regarding the variation in readings of the different types of meters and has found that a variation of 4 db is not uncommon.—ADAM L. CURRIE, Chief Research Engineer, L. J. Wing Mfg. Co.

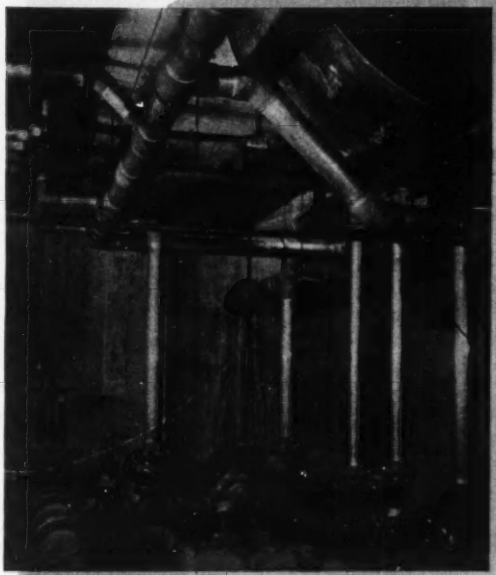
LIKES ARTICLE ON TANK SUPPORTS

I THINK THAT THE article in the June HPAC by Theodore E. Bridge, on supports for a horizontal tank, was most interesting.

To my knowledge, few articles dealing with this subject have ever been published. The assumptions made by Mr. Bridge in his analysis are on the safe side, and his procedure is sound.

I have designed several structures in the past upon which little or no design information was available, and am therefore glad to see such an article as this.—GUSTAVE M. GOLDSMITH, Registered Professional Engineer.

Now, it makes more sense than ever to use...



ONE VITAL SPOT where Revere Copper Tube can be used is in the conveying of liquids in industrial processing. Here is just the place for Revere Copper Tube to show its true worth. For it is non-rusting and will resist the corrosive action encountered in many of the process applications.

UNDERGROUND Revere Copper Water Tube resists the corrosive action of water inside and that of the soil on the outside. It can be bent around obstructions; made to follow the contours of the ground. Its long sections, which may be had in coils, are easier to handle, require fewer fittings.

COPPER WHERE IT COUNTS!

USING Revere Copper in the vital spots has always made common sense. Now, with copper restricted for some uses and limited for others, it becomes even more important to use "Copper Where It Counts!"

Three of these places are: industrial process lines, underground service lines and for domestic hot and cold water lines. Revere Copper Water Tube can be used for these purposes. So, whether you are a contractor, engineer or builder it will pay you to specify and use what copper you *can* get where it will do you and your customers the most good. That means in the spots where rustable materials can't stand the gaff.

Revere Copper Tube is non-rusting, has high corrosion resistance, is easily worked, installation costs are no more than for short-lived materials. It is joined with solder or compression fittings. Revere Copper Tube is ideal for replacement as it is readily bent, requires fewer fittings. It is available in hard and soft tempers, in straight lengths; also in 60′ coils in soft temper. Each length is marked with the name Revere. Look for this mark. It assures uniform quality.

To maintain your reputation for top-quality jobs, while metals remain short, use Revere Copper Water Tube wherever you can. The Revere Technical Advisory Service will be glad to help you in every way possible. Avail yourself of this service through your Revere Distributor. Call him today.

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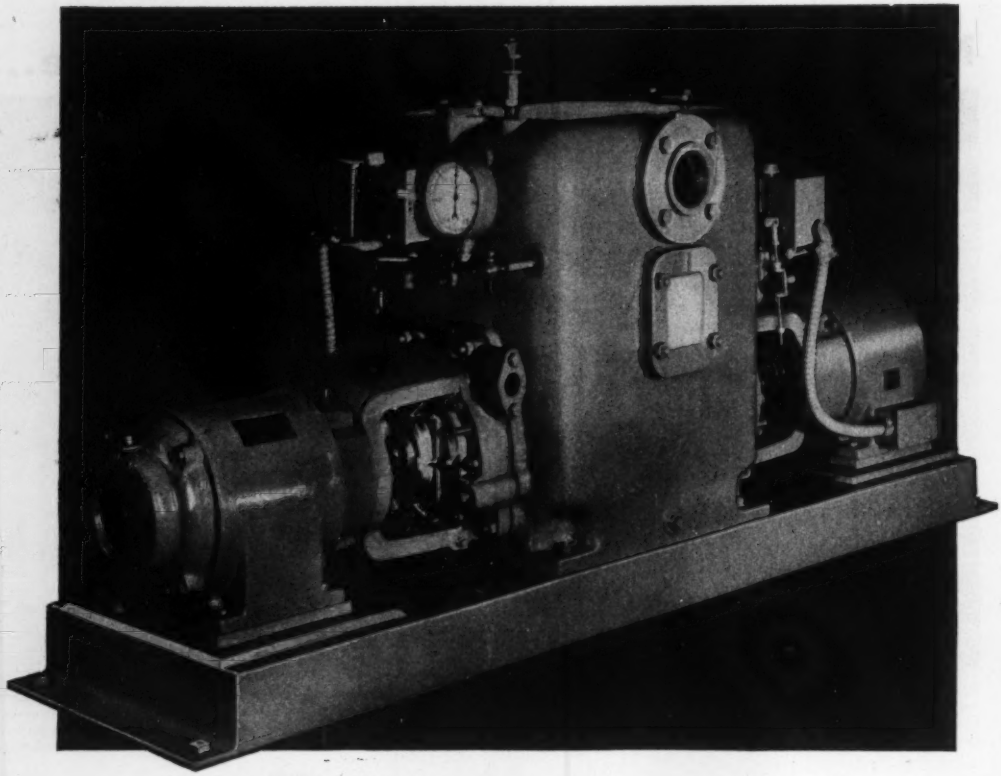


THE HEATING PUMP WITH CERTIFIED PERFORMANCE

A Jennings Return Line Vacuum Heating Pump may be installed with the absolute assurance that it is of the proper capacity to keep your heating system at top-notch efficiency.

For the actual working capacity of your Jennings Pump is determined by careful tests under working conditions, and with the actual motor that goes on your job, regardless of current characteristics. Every Jennings Pump has to deliver full rated capacity of air and water simultaneously before it is released.

The Jennings Heating Pump has everything in the way of safety, convenience, and real dollar saving economy that years of experience as leading heating pump manufacturers have enabled us to put into it. Quality is backed by an unchallenged reputation, and satisfactory performance is assured by a nation-wide network of Sales and Service offices.

THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.

Film Produced by Contractor Shows Power Piping Installation

Phillips, Getschow Co.'s Color Movie Explains Details of Large Power Station Piping Project

PHILLIPS, GETSCHOW CO., heating, piping and air conditioning contractor, Chicago, has produced a 16 mm motion picture in color and sound showing the construction of a large power station piping system. Roy M. Getschow, president of the firm, is a past president of the Heating, Piping and Air Conditioning Contractors National Association, and the film was first publicly shown at this year's annual convention of the HPACCNA in Washington, D. C.

The film, in its 22 minutes of running time, does an excellent job of showing and describing the experience and facilities a piping contractor must employ in the installation of a modern piping system. Not only is it of general interest but — as it describes the design and installation details of an actual project — the information presented is of specific value to piping designers, engineers, fabricators and other contractors.

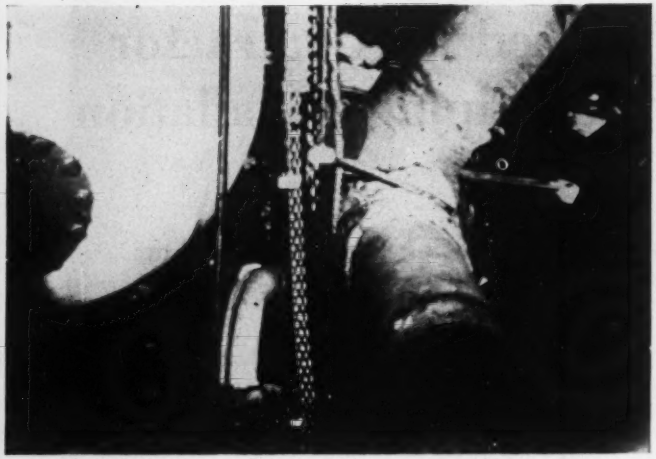
A few shots giving an overall idea of the size of the power station introduce the film — each boiler as high as a 12 story building, capacity of each boiler 730,000 lb per hr of steam, 83½ miles of tubing in the condensers, operation at 1800 lb steam pressure and 1050 F temperature, etc. The story then swings into the piping facilities, details of installation, and the methods and equipment used on the project.

Complete Pipefitting Shop on Job

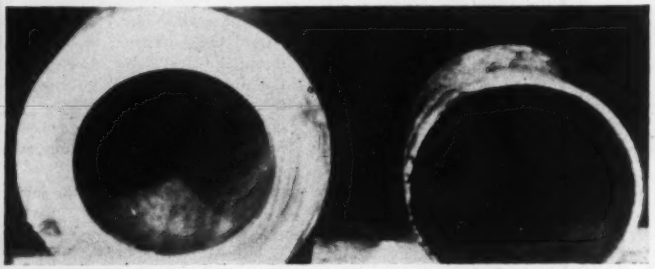
The film explains that there is a complete pipefitting shop set up on the job and there is a very striking sequence of pictures showing the forging of eyes for pipe hanger rods in this shop as well as the torchcutting operations on these hangers. It is also pointed out that there are 48 arc welding machines used for the pipe welding and that these are set up in banks throughout the building.

The next series of pictures shows a fabricated section weighing some 13 tons — a part of the main steam header — and illustrates the hoisting of this large section of fabricated piping. The accompanying comment points out that the big section had to be "literally woven" into place because of the various obstructions and that the piece had to be handled with extreme care to prevent causing any stress concentration. A 100 hp double drum hoist was used by the piping contractor to raise such heavy sections — weighing up to 35 tons. In order to control the hoist, a portable pushbutton system

48 ARC WELDING machines were used in the pipe welding on the job and were arranged in banks

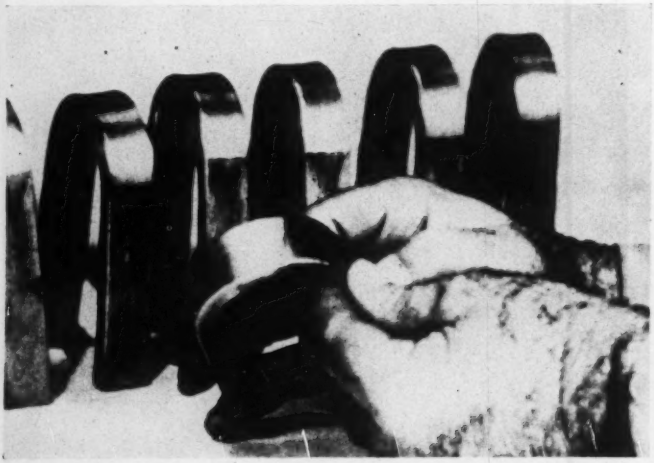


THIS SECTION OF the main steam piping had to be carefully hoisted into place using a 100 hp double drum hoist. A 35 hp hoist was available for smaller assemblies



A COMPARISON of the hollow bored tube and standard pipe is given in this view

WELDERS WERE QUALIFIED in accordance with code requirements, and the film explains the different test specimens and shows them being tested



operating signal lights at the hoist was carried by the pipefitter directing the hoist. By means of this signalling system he had perfect control of the hoist throughout.

The same header piece is next shown in its final location, welded into place, and it is pointed out that massive roller suports for this and many other parts of the piping installation are used as well as many spring hangers to allow for expansion. Another shot at this point shows a large motor operated steam valve, weighing approximately 5 tons, of the bonnet seal type, and it is mentioned that there is a steam line from each boiler, each with a stop and check valve.

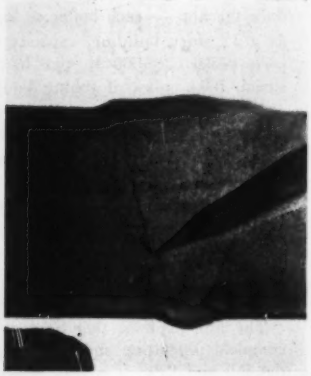
A smaller double drum hoist of 35 hp was used for piping assemblies weighing 10 tons and less. Hand signals were used to direct the operation of this smaller hoist.

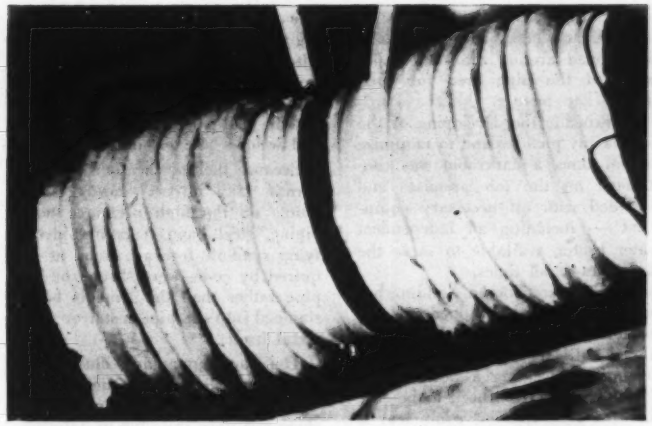
The film then illustrates the hydrostatic testing of the piping after its erection in place.

Welding 3¼ In. Wall Alloy Piping

Hollow bored forged tubing of approximately 3¼ in. wall thickness and weighing 550 lb per lineal ft is used for the main steam piping, and the size and wall thickness is compared with a piece of standard pipe. Five suggested welding grooves for this 2¼ percent chromium, 1 percent molybdenum piping were studied and models of these grooves are pictured. The narrator points out objections to some of the grooves con-

FIVE SUGGESTED welding grooves were considered, and the film explains the reasons for the choice of the one used





HEAT TREATMENT of the welds is explained in detail and one of the charts showing the temperatures maintained is described and analyzed. This view shows preheat coils in place

AIR DRIVEN SCALING hammers are used for chipping the welded joints, followed by grinding with an air driven grinder, as shown here. A quick shutoff device is used to provide rapid change from hammer to grinder

sidered — too sharp an angle, too wide at the top, too long to make the weld, etc. — and then describes the welding groove chosen and its chill or backup ring.

The specifications of course required that the welding be done in accordance with the ASME code and that the welding procedure and the operators be qualified in accordance with code requirements. The film then explains these requirements in some detail and shows the various types of test specimens cut from the welds. The reduced section specimens are shown being pulled apart in the testing machine — getting thinner and thinner and finally breaking — with the gage indicating the pressure seen as the section is pulled apart.

The fixtures used in accordance with the code for bending the specimens for the free bend tests are illustrated in the film, and the specimens are then shown in the testing machine being bent still further. It is pointed out that when the qualifying of the operator has been completed and approved, he is ready to start the actual pipe welding work.

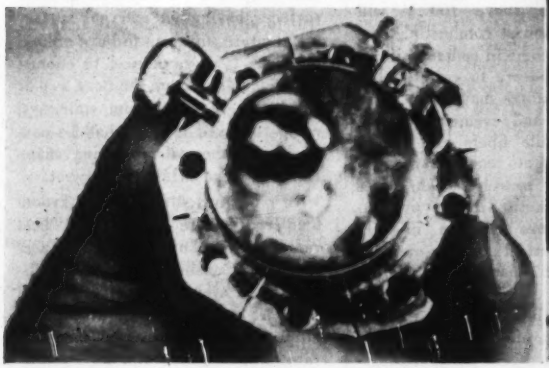
The film then shows in some detail the actual welding of piping joints and illustrates the induction heating of the joints for preheat and heat treatment. One of the record charts showing the temperatures of a joint before, during and after welding is illustrated in detail and carefully described.

Close-Up View of Actual Weld

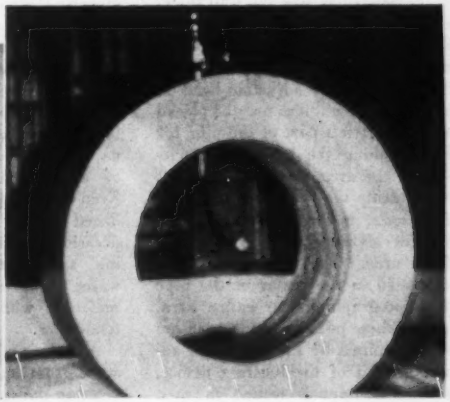
A particularly interesting sequence shows a close-up view of an actual weld, and in these pictures the metal leaving the electrode and being deposited in the joint can be seen. It is pointed out that the quality of the joint is governed by the ability of the operator to fuse the metal with that already deposited.

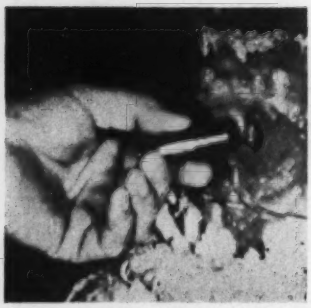
When each layer of weld metal has been deposited, an air driven scaling hammer is used to remove scale,

A SPECIALLY DEVELOPED radium capsule holding and locating device is used in the gamma ray inspection of the pipe joints



HERE THE RADIUM capsule holder is installed in a full scale wood pipe model to show how it is used. It requires only a ½ in. access hole in the pipe wall





AFTER GAMMA RAY inspection, the access hole is plugged, seal welded and ground smooth

after which the hammer is removed and replaced with an air grinder. An automatic shutoff device is used on the air hose so that a quick change from hammer to grinder can be made.

Gamma Ray Inspection of Welded Joints

Specifications for this piping project required that each joint be inspected by gamma ray, and a special radium locating and holding device for 300 milligrams of radium was used. With this device, the radium can be positioned accurately within the pipe for making the gamma ray pictures and its use requires only a ½ in. instead of a 2 in. access hole in the pipe.

The film pictures this locating and holding device with its radium cartridge and its adjusting head. The rod of the device — which rod connects the adjusting head and the radium cartridge — is first checked against a template to assure that it has not been bent or twisted out of the correct shape. The cartridge with the correct amount of radium for the particular size and wall thickness of pipe to be inspected is then fastened to the rod, and the rod is inserted into the pipe.

By means of the adjusting head on the device, the radium may be placed in the upper left part of the pipe for photographing the lower right one-third of the area, in the upper right for picturing the lower left one-third of the area, and in the bottom of the pipe for showing the top one-third of the area. The radium may also be spotted in the center of the pipe for photographing the entire area. Each of these positions of the radium is determined by the calibrated adjusting head of the locating device, and the radium is locked in each position by means of set screws on the adjusting head. The film itself is wrapped around the correct position of the pipe area for each gamma ray picture.

To expedite the developing of the gamma ray pictures and to minimize loss of time, a darkroom was constructed on the job premises and provided with all necessary equipment — including an independent water heater available to serve the darkroom at all times.

After the first inch of welding has been completed, the chipper proceeds to clean the weld and cleaning continues until the weld is completed. During the welding a portable pyrometer is used to check to be sure that the heat treating equipment is maintaining the proper temperature.

Welds Ground To Avoid Stress Concentrations

Upon completion of the weld, it is ground in accordance with the specifications to eliminate any stress concentration points, and after grinding the weld is again gamma rayed. After the development of the gamma ray exposures and their inspection and approval, the ½ in. access hole for the radium capsule is blocked, seal welded, and ground smooth.

Because the specifications did not permit any stress concentration points on the high pressure steam piping, steel bands carrying identifying symbols for each weld, as required by code, were shrunk on the pipe rather than the symbols being stamped into the pipe metal or weld metal itself.

The accompanying illustrations have been selected with the cooperation of Phillips, Getschow Co. to show not only the type of information given in the film but also to indicate the methods and equipment employed on a piping project of this nature. These pictures are taken from the film, and are therefore not as clear for "still" reproduction as might be desirable.

Heat Insulation Aids Plant Safety

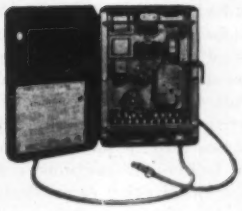
WHILE THE HEAT escaping from an uninsulated steam line or exhaust flue may or may not have economic value, it can start a fire costing thousands of dollars. Also, employees working in the vicinity of exposed hot surfaces are in constant danger of being burned by brushing against a hot line or a hot flue. To avoid this fire and safety hazard, warns the Magnesia Insulation Manufacturers Association, hot lines and equipment should be insulated regardless of economic considerations.

According to A. S. Hall, of the engineering division of the Factory Mutual Laboratories, any surface at a temperature above 700 F will quickly ignite most combustible materials which come in contact with it. Prolonged exposure to considerably lower temperatures may cause gradual charring and eventual ignition of wood, textile fibers and paper. Even the moderate temperatures produced by low pressure steam pipes occasionally cause fires by promoting spontaneous ignition in oily waste, paint-soaked clothing or other materials with spontaneous heating tendencies.

An uninsulated metal exhaust stack from an oil fired furnace, located in the storage room of a paperboard plant, ignited roll paper accidentally piled against it and the resultant fire caused damage exceeding $100,000. In another instance, a bare pipe carrying 12 lb steam passed through a rayon waste storage bin. The pipe caused charring and eventual ignition of the waste in contact with it and the fire spread to nearby bins. The damage was $9000.

Some state industrial safety codes require heated surfaces to be insulated, for the protection of plant workers. The general industry safety orders issued by the California Department of Industrial Relations state that ". . . . exposed metallic surfaces having an external surface temperature sufficient to burn animal tissue . . . where subject to contact within 7 ft . . . from the floor . . . or within 15 in . . . from stairways, ramps or fixed ladders shall be covered with thermal insulating material . . .", the MIMA points out.

In numerous situations, workroom temperatures are increased by heat radiated from uninsulated surfaces to a level causing acute worker discomfort or even to the point of health hazard. Studies have shown lowered efficiency and increased accident rates under such conditions.



Electronic Safeguards for Oil Burners

By Kalman Steiner and Wilmer G. Carter

Electronic instruments and controls find numerous uses in heating, piping and air conditioning work, and in the July issue the authors gave a brief but clear explanation of electronic fundamentals to assist understanding something of the design, application and maintenance of such equipment. The present article follows up with short descriptions of typical available forms of flame safeguards for use with commercial and industrial oil burners. The authors are with C. Hoffberger Co., and Mr. Steiner is a member of HPAC's board of consulting and contributing editors

WE DISCUSSED BRIEFLY, in an article in the July HPAC, fundamentals of electronics helpful in understanding the nature and functioning of electronic devices used in heating work. This month's article describes a few typical commercial forms of flame safeguards designed for use with commercial and industrial oil burners.

It should be understood that the systems described were selected merely in order to illustrate a class or type of equipment, as an article of this length could not attempt to discuss all available makes of such equipment.

Three Distinct Types of Systems

One manufacturer of combustion safeguards offers three distinct types of systems.

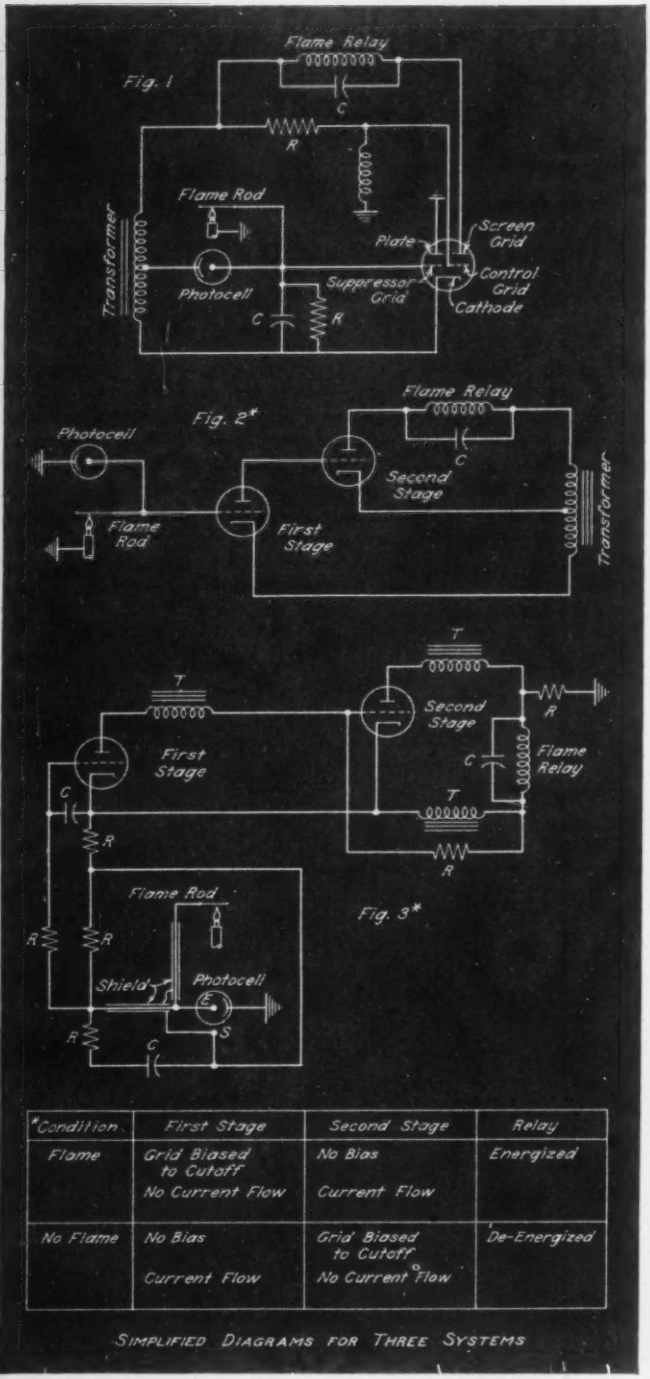
The first encloses a photocell and an electronic relay within a single housing that must be mounted directly on the boiler front to monitor the oil flame. Electrically, it replaces a stack switch, and final action is merely to complete the stack switch action required by some other form of primary control. It exercises no supervision over the pilot or ignition cycle; its purpose is to shut off the burner instantly should flame failure occur during the running cycle.

The second type employs a primary relay panel embracing a sequence programmer, which in one version connects to a separately mounted photocell only to give the same flame supervision as does the first type and its associated primary controller. In another version, it also embraces in the electronic circuit a probe rod that reaches into the region where the igniting gas flame burns to give monitoring of the igniting cycle and the running cycle.

The third type has a primary program relay, wall mounted, and a single flame detector sensitive to infrared that monitors both the gas flame and the oil flame. This system was recently developed, and represents an important step forward, in that it combines two devices into one and renders the probe rod unnecessary.

The second type (described above) employs a pentode tube in its electronic circuit. This single tube does the work of two amplifier tubes. It is so applied to the circuit that the plate, suppressor grid and cathode serve as the No. 1 tube, and the screen grid (used as a plate), control grid and cathode make up the No. 2 tube. Fig. 1 shows the electronic network diagrammatically. With both gas flame and oil flame absent, current flows through the first stage to bias the second and prevent current flow to the flame relay. [Note: *Bias* is explained in the July article.] With either a gas flame touching the electrode probe or light from the oil flame striking the phototube, the suppressor grid becomes biased to cutoff, removing the current flow that biases the second stage, thereby allowing current flow to the flame relay, which permits burner operation to continue. Upon burner shutdown, both the probe rod and the photocell must be cleared to allow the flame relay to resume the starting position.

When applied to an automatic oil burner for full flame safeguard, the burner mechanism starts from impulse from a temperature or pressure controller, with the ignition coming on immediately. Should the gas flame ignite in the normal manner, the flame relay pulls in and clears the circuit to the main fuel valve through a timer which can be set for delaying the opening of the fuel valve for a given number of seconds (5 to 30) after starting. At the end of the delay period, the timer completes a circuit to the fuel valve, which then opens and the oil flame becomes established. The gas pilot continues to burn through the remainder of the ignition period, which can also be set for a given number of seconds (30 to 80). Failure of the gas to ignite at the beginning of the starting cycle blocks the opening of the oil valve and results in shutdown at the end of the ignition period. Likewise, should the gas ignite and cause opening of the oil valve,



*Condition	First Stage	Second Stage	Relay
Flame	Grid Biased to Cutoff No Current Flow	No Bias Current Flow	Energized
No Flame	No Bias Current Flow	Grid Biased to Cutoff No Current Flow	De-Energized

SIMPLIFIED DIAGRAMS FOR THREE SYSTEMS

but should no oil flame result, upon completion of the ignition cycle, shutdown results. After a safety shutdown, a reset button must be pressed manually to commence another starting cycle. If power failure occurs during normal operation, the starting cycle automatically repeats.

When used to safeguard manual start burners, no gas probe is used. Some sort of switch or pushbutton is closed to initiate burner operation, the oil being lighted from a torch. As soon as the photocell receives light from the oil fire, it completes a circuit that continues to hold the burner in operation. Flame failure causes immediate shutdown of the burner, and of course no recycling is permitted on manual ignition burners.

Principle of Rectification Used

Another manufacturer bases its combustion safeguards upon the principle of rectification of alternating current to direct current both by the gas flame electrode and by the phototube. This rectified current actuates a flame relay through a vacuum tube amplifier of the duo-triode type; that is, two triodes within a single envelope. The d-c flame current puts a negative bias on the grid of the first amplifier stage or triode. Absence of flame permits passage of current through the first stage; rectified d-c from a flame interrupts the current flow. The plate of stage No. 1 connects to the grid of stage No. 2, and any current output of the first tube becomes the bias charge of the second tube. When current flows across stage No. 2, the flame relay becomes energized and the burner operates. Hence, lack of flame, by permitting current flow through stage No. 1, biases the second stage to cutoff, shutting down the burner. Presence of flame biases stage No. 1, preventing current flow to stage No. 2; stage No. 2, being without bias charge on its grid, passes sufficient current to actuate the flame relay and keep the burner running.

As with other automatic systems, upon call for heat a starting circuit becomes established, which will persist only for a short interval (60 to 120 sec). During this starting interval, the electric spark must ignite the gas pilot to permit the oil valve to open; the oil flame must become established and send light rays into

the photocell. Failure of any portion of this sequence will result in burner shutdown at the end of the starting interval. Non-recycling systems will, in the event of safety shutdown, take a lockout position, requiring manual recycling. Others, of the recycling type, will again attempt the starting sequence.

This manufacturer's flame rectification principle depends upon the flame, the ground area and the electrode area collectively acting as a rectifier to pass more current in one direction than the other. Although alternating current is applied at the flame and ground terminals, the circuit functions from the effect of d-c on the amplifier circuit of the electronic network. As there is nothing within the electronic network or within the relay that can supply d-c, either the gas flame probe rod or the phototube must do so. In the gas pilot assembly the element that is grounded has a large area compared to the anode (probe rod of the igniter assembly). The large cathode area permits relatively large current flow in one direction, while the small anode area minimizes current flow in the reverse direction. The result is, for the purposes of the electronic system, a rectified or unidirectional current. The photocell used in this network is itself a rectifier and supplies d-c after the ignition period, provided light from a flame falls on the cathode, which is coated with ceasium oxide.

This manufacturer's electronic safeguards may be grouped into three categories. The first is principally for domestic oil burners, and is self-contained. The second must be used in conjunction with a conventional panel which already incorporates ignition timing and fuel valve timing. The third combines the functions into a single panel, and in it the conventional magnetic relays and bi-metallic timers are replaced by electronic circuits.

Available for Manual, Automatic Systems

A third manufacturer has flame controls available for manual ignition and fully automatic systems. For manual ignition, the flame control connects to a photocell only, with pushbutton starting. For automatic operation, the system adds a probe rod for the gas pilot flame.

The electronic network embodies a duo-triode vacuum tube, or two complete triodes within a single envelope. A common heater serves the two cathodes. Connections between the control, photocell and flame rod are made with shielded cable or co axial cable. Shielded cable consists essentially of a center conductor, insulation, a copper sheath and more insulation. When both flame rod and flame eye are used, the probe rod is in parallel with the anode or center post of the photocell. The photocell cathode is grounded directly; what would be equivalent to the cathode in the flame rod, the electrode holder, connects to the sheath or copper shield of the shielded cable, which in turn connects: through a condenser and resistor to the "eye" terminal on the panel; through a resistor to the cathode of the duo-triode; and through branch circuits with resistor and condenser, respectively, to the "eye" terminal and to the grid of the first stage of the amplifier tube.

Current will flow through the first amplifier stage so long as there is neither flame rod nor photocell action. Current flow of the first stage biases and blocks flow in the second stage and de-energizes the flame relay. Action by the flame rod or eye blocks flow in the first stage and permits the energizing current to flow through the second, holding in the flame relay and allowing the burner to continue in operation.

The control contains a timing motor that causes contacts to perform the required sequence: starting burner motor and fuel pump but holding off ignition and fuel valve; igniting gas pilot and proving it; opening fuel valve and proving oil flame. There is a purge period on startup to allow sweeping accumulated gases from the firebox before the ignition comes on.

Maintenance Suggestions

Electronic circuits are susceptible to the presence of soot deposits. Most systems are designed to fail safe; that is, to prevent burner operation whenever an unsafe condition develops. Grounding of the electrode or its holder, or presence of flame during the burner off period, prevent recycling until the disturbance is cleared. Photocells and amplifier tubes gradually wear out; the output of the latter can generally be tested with a milliammeter and a few simple sockets and switches; the quickest test for a phototube is to try a new one if the flame relay fails to pull in when the oil flame lights.

Each system involves servicing peculiar to itself, which the operator can easily learn from the manufacturer's manual. Common causes of trouble on electronic safeguards are: soot deposit on guard glass in front of flame eye, blocking passage of light to photocell; carbon formation in pipe to which photohead is attached, blocking passage of light; failure of flame rod to touch pilot flame or of flame eye to see oil flame because of misalignment of instruments; pitted contacts or bent contact strips in relays.

URGES STATES TO CERTIFY ON GAS CONTROL

REACTION OF THE gas appliance industry to the August 15 order by the Petroleum Administration for Defense restricting the use of natural gas for new heating and industrial installations took the form of an appeal to public utility commissions of the affected states to assert their readiness to handle restrictive measures on a local basis.

H. Leigh Whitelaw, managing director of the Gas Appliance Manufacturers Association, called the order an "invasion by PAD of a field in which the states' regulatory commissions are better qualified and are already exercising jurisdiction.

"The Senate conferees on the bill to amend the Defense Production Act must have shared this view when they accepted the Bow amendment, which prevents federal intervention in natural gas regulation wherever a state public utility commission certifies to the President that it has taken defense requirements into account," Mr. Whitelaw said.

"The gas appliance industry understands perfectly well the necessity for any order which is essential to the defense effort and for years has been operating under gas restriction orders issued by the states. The industry's own defense effort bears out its interest in the nation's welfare. Our main concern, however, is with the centralizing in Washington of controls that normally belong to the state and with which the state has demonstrated its ability to cope," Mr. Whitelaw said.

THAT AIR CONDITIONING is a necessity in submarines has been indicated repeatedly. Problems of atmospheric, temperature and humidity control become even more pressing when they are designed to remain submerged for longer periods. (Official photograph, U.S. Navy)

Navy Has Pressing Air Conditioning Problems

By Captain T. L. Willmon, MC, USN

Navy environmental problems offer a challenge to the air conditioning profession, including those engaged in the design, manufacture and installation of air conditioning and refrigeration equipment. While the Navy's needs naturally place severe demands on air conditioning systems, many of the points brought out in this discussion pertain also to plant and building applications

IN THE RECENT words of the late Admiral Sherman, I think the Navy is in pretty good shape. He was speaking of its adequacy and effectiveness—I am talking of environment and habitability.

Of course, such a statement is relative and comparative to conditions which existed in the past. Problems still are with us. Some environmental unpleasantness and even hazards may need be accepted as considered risks. For instance, there must be a compromise in troop transports between desirable environmental conditions and the necessity of carrying to the front as many men as possible. Air conditioning and less crowding would be desirable, but due to operational requirements crowding is continued and air conditioning is not installed.

The wild heat in naval vessels undoubtedly always will be a problem. For example, in the ship in which I served at the last war's end, the USS New Jersey — to me, the world's finest battleship — during general quarters in the southwest Pacific when the ship was completely closed, interior habitability was barely tolerable. Air conditioning was limited to the combat information center and the sick bay.

I shall never forget an overnight experience waiting for my ship, in a large transport anchored as a station ship. I was berthed in the second deck forward, in a room perhaps 20 x 12 with a 10 ft overhead, fitted to the maximum capacity with triple deck bunks. I had no measure of the temperature, humidity or air movement, but they were of such order that I sat out on deck for sev-

Captain Willmon is Officer-in-Charge, U.S. Naval Medical Research Laboratory, U.S. Naval Submarine Base, New London, Conn. His article is based on an informal talk he gave at a meeting in Cleveland attended by some members of the American Society of Heating and Ventilating Engineers technical advisory committee on physiological research and some members of the American Physiological Society.

eral hours rather than turn in. I finally retired and, from sheer exhaustion, fell asleep — to awaken some time later with the sheet and mattress drenched with perspiration.

After a most restless night, an older friend with whom I was travelling and I dressed, feeling nauseated, dizzy and extremely weak. Either of us could have diagnosed the condition easily in someone else and under conditions more conducive to clear thinking; but only after considerable delay did it dawn on me that our illness resulted from salt and water loss. After a quart or more of tomato juice and a handful of salt tablets, our recovery was rapid. This was a modern and powerful ship, but such problems in environment still exist.

Undoubtedly some of you have been aboard our new cruiser, the Newport News, which is fully air conditioned and in which many of us have put our faith as being the greatest forward step in fighting ship habitability since some poor sailor smothering under sun-drenched teakwood decks and bubbling tarred seams discovered the wind scoop.

A submarine is a cigar-shaped craft as long as a football field, divided into nine watertight compartments, powered on the surface by diesel electric drive and while submerged by electric motors energized by storage batteries. Ventilation of the ship while surfaced is effected through air induction lines originating in the conning tower. During submergence, the air within the ship is recirculated and is cooled and dehumidified by air conditioning units. As necessary, air may be revitalized by the addition of oxygen and absorption of carbon dioxide. Contrary to common belief, only a negligible increase in atmospheric pressure occurs in the submarine during a normal dive.

Air Conditioning Is a Necessity

The submarine environment in general is under reasonably good control because of air conditioning. That air conditioning is a necessity has been repeatedly indicated during periods when the equipment failed or was secured for strategic reasons. Perhaps the best documented illustration is the following quotation from a war patrol report:

"All hands stripped down to shorts; socks and shoes were removed, despite which men perspired excessively until, in an hour or so, the decks were slippery with sweat. Towels used to keep perspiration out of the eyes became wringing wet; socks could be wrung out like rags. Every one drank a great deal more water than usual and took salt and aspirin tablets. As time went by, the air became oppressive and stifling, and it was difficult to breath; headaches were prevalent and severe. As the youngsters folded up, the older and more phlegmatic men would take over. Some without permission, others after requesting relief, would quietly leave their stations and lie down on the coolest spots of decking. Occasionally stations ended up with two men taking turns, the off-watch man resting on the deck beside his station."

Of no less importance than habitability is the dehydrating protection afforded by air conditioning to electronic equipment — a factor which, during the last war, enabled our submarines to operate more effectively and with less electric and electronic difficulty than the submarines of other nations not so fortunately equipped. The submarine of tomorrow is being designed with provision for increased refrigeration and air conditioning facilities.

Quiet Machinery Must Be Developed

A submarine's greatest defense is her ability to slip quietly into or away from a position of danger. Once her presence is disclosed to the enemy, she is in great danger. It is most desirable that her operations, her personnel, her equipment and her machinery be maintained in a state of extreme quiet.

This is particularly true in the function of one submarine hunting and killing another, a concept based on the idea that "a thief can best catch a thief." It is analogous to two men blindfolded, being armed with clubs and engaging each other in mortal combat. Obviously, the man who makes the first and consistent noise is at a tremendous disadvantage.

So submarine designers are most interested in efforts to develop quiet machinery. Air conditioning equipment is shut down for extreme quiet running, resulting after a few hours — particularly in tropical areas — in almost intolerable habitability. In addition to quiet air conditioning equipment, it is hoped that refrigerating equipment can be developed which will be more economical in space and weight requirements.

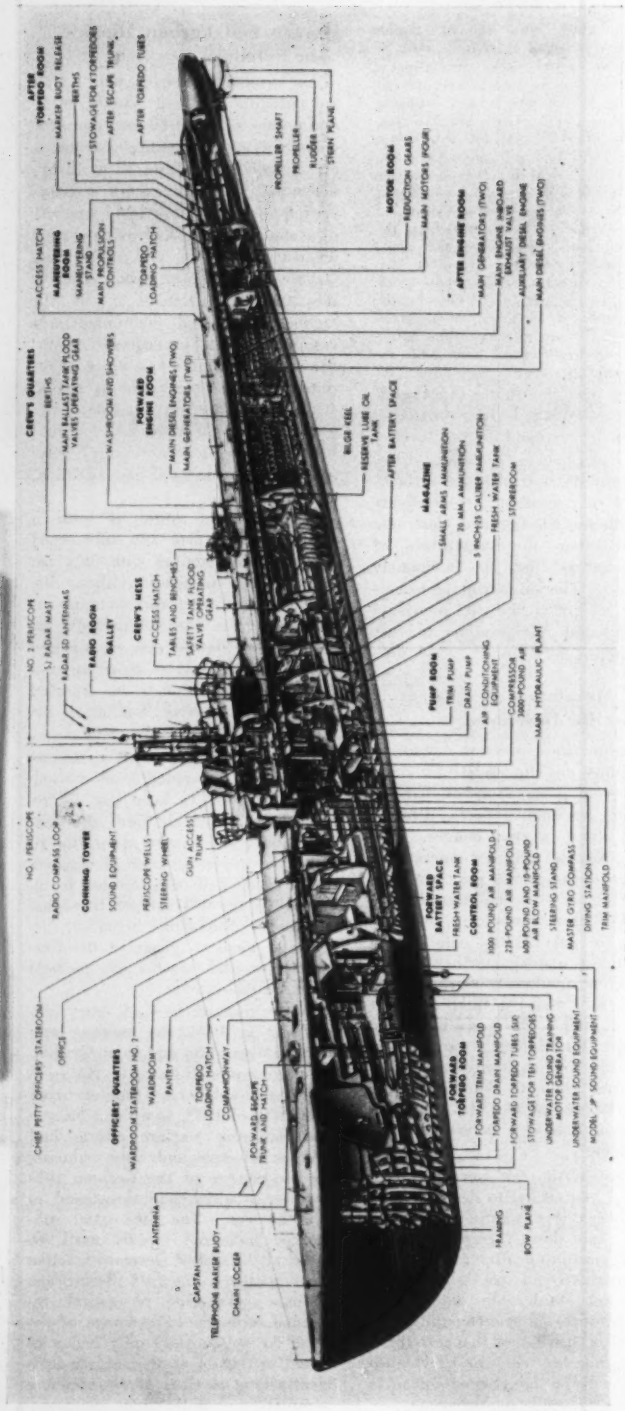
Oxygen and Carbon Dioxide in Submarines

The present submarine, with a free air capacity of about 35,000 cu ft and a crew of about 80 men and in a completely closed condition, requires air revitalization within 12 to 15 hr, depending upon the crew's activity. Carbon dioxide is absorbed by means of granular lithium hydroxide spread on mattress covers and table tops. Oxygen may be bled from cylinders into the compartments, or, if not tactically precluded, the submarine's compressors may be utilized to withdraw submarine air to a point of reduced pressure equivalent to 10,000 ft altitude, following which air from a fresh air bank may be bled into the boat to restore normal pressure and depleted oxygen, and to dilute carbon dioxide.

A submarine equipped with a snorkel device may run submerged on her diesel engines with only the snorkel tube protruding above the surface. With each diesel engine exhausting from the submarine's interior 5 to 10,000 cfm of air and thus requiring that an equal amount be drawn in through the snorkel tube, quite effective ventilation occurs in the snorkel submarine.

Strategically, however, a submarine may be prevented from snorkelling sufficiently to keep her air replenished, in which case, she will again have to resort to absorption of CO_2 and replenishment of oxygen. I think you will be interested in information on this subject furnished me by Dr. Karl-Ernst Schaefer, formerly a medical officer in the German navy and now of our medical research laboratory.

At the time of the U. S. entry into the war in 1941, the average submerged time of an underway German submarine was 10 percent. No great increase in submerged time occurred until May of 1943, at which time our antisubmarine warfare efforts had become effective and were reducing the supremacy of the German submarine — which had threatened to win the war. The time spent submerged increased rapidly until, in 1944, at the end of Germany's active participation in the war, the average German submarine on patrol remained submerged 80 percent of the time, the submarine rarely being allowed to remain on the surface sufficiently long to clear her atmosphere completely. With this condition,



OF NO LESS IMPORTANCE than habitability is the protection afforded by air conditioning to a submarine's electronic equipment

morale and physical effectiveness were at a low ebb. The men were described as being vegetative, slow in response, and physically and mentally ineffective.

The submarines of our Navy have never experienced a consistent program of harassment comparable to this, due to the fact that we have not yet encountered an opponent of sufficient prowess. However, we must make provisions for the danger that our submarines can be invalidated through being forced down, made to stay down and thus rendered ineffective by their own carbon dioxide.

The problem is not soluble practicably by increasing the allowance of CO_2 absorbent cannisters. For a 50 day patrol under the conditions experienced by the Germans, it is calculated that 15 tons of CO_2 cannisters, requiring about 1000 cu ft of storage, would be required to maintain a state of satisfactory habitability.

Atmospheric Control a Pressing Problem

Looking into the future and the possibility of the new submarine ultimately becoming a true submersible which can remain submerged for weeks on end, the problems of atmospheric, temperature and humidity control become even more pressing. It is believed that a continuous knowledge and recording of the constituents of the submarine's atmosphere is mandatory, for the same reason that an engineer must know his fuel oil supply. The components which seem needful to know and for which continuous analysis and recording are planned include oxygen, carbon dioxide, and hydrocarbons, hydrogen, possible carbon monoxide, and trace substances. These latter depend on engineering developments which may evolve noxious agents not currently of importance.

Efforts are being made toward the development of apparatus which will enable carbon dioxide absorption as may be required without depletion of the absorbent. Bubbling the atmosphere through sea water was attempted by the Germans and has been investigated in this country, but found to be unfeasible due to the relative inefficiency of the process and the attendant noise of the compressors or other apparatus. It is believed that suitable absorbing equipment will have been developed

by the time the need is with us.

Of interest at this point is the question of the maximum allowable carbon dioxide concentration for an indefinite time. The literature contains considerable information on the effects of CO_2 contents of 3 percent and upward. There is excellent evidence that 3 percent CO_2 breathed over a period of days induces a vegetative state in man with lowered body temperature, decreased O_2 consumption, markedly decreased alertness and ability to concentrate. Under such an atmosphere, Schaefer reports endocrine gland deterioration in guinea pigs.

Perhaps, however, there is a lesser concentration which man can breathe indefinitely without damage, discomfort or loss of physical, mental or psychological effectiveness. If, for example, 1 percent or even ½ percent CO_2 is acceptable, then perhaps the weight and mass of CO_2 removal equipment required to maintain a CO_2-free atmosphere can be reduced to a small fraction of its anticipated size. Space in a submarine is that of which there is least. We are engaged now in determining effects of prolonged exposures to low concentrations of CO_2.

Oxygen for replenishment of the atmosphere is carried currently in conventional 1.5 cu ft flasks at a pressure of 2 to 3000 lb. It appears feasible — and investigations are promising — to employ liquid oxygen where perhaps 80 percent of the weight and volume would be usable oxygen and 20 percent would be in the container, in comparison to gaseous oxygen in bottles where this ratio of oxygen to container is approximately reversed. The chief planning deterrent in the use of liquid oxygen is the ubiquitous fire hazard.

We read in the newspapers that the most feasible power source for the true submarine is the atomic pile. It is difficult to conceive that such a power plant can be so shielded and isolated that no hazard can arise under any conditions but whether there may be radiation problems, or what the degree of such problems is, must remain for the future.

Operations in Cold Areas

In a cold area, a submarine is inevitably a cold piece of mechanism, the hull being surrounded by and approximately at the temperature of sea water. Except while cruising on the diesel engines, little heat of combustion is present. There are no steam pipes and, compared to the steam powered surface craft, wild heat is almost nonexistent, other than the relatively small sources of heat from batteries, engines and other machinery. Comfort heating currently supplied by electric radiant space heaters strategically spaced through the ship may be limited operationally by the power drain imposed.

The caloric requirements of personnel may be taken as an index of the environment. It has been found, for instance, that personnel engaged in Arctic land operations or maneuvers have required as high as 5500 calories per day in comparison to their requirement of 3500 to 3800 in temperate zones immediately preceding a northern expedition.

In a recent experimental patrol of two submarines for 40 days in Arctic waters, measurements were made of the caloric requirements of the crews. An intake of 3800 calories in the New London area was found to be unchanged in the Arctic. This is interpreted to indicate that under conditions of this study, no significant decrement of habitability was effected in the submarine incident to operation in Arctic waters. The temperature within the submarine was cool but reasonably comfortable except in the forward and after-rooms, where temperatures as low as 45 F were observed, whereas the troops and surface craft sailors were combating low temperatures when a large energy expenditure was required even to maintain metabolic requirements. The submarine environment under prolonged extreme cold has yet to be determined.

Particularly in northern waters, every piece of bare metal in a submarine's interior acts as a condenser and drips water incessantly. To combat this, the hull's inner surface and bulkheads are insulated with cork. Additionally, the air conditioning equipment may extract from the atmosphere as much as 100 gal per day of water.

It has been suggested — and considered feasible but economically impractical by marine engineers — that the cold bare metal inner surface of the hull be utilized as a condenser on which the air's moisture content would be deposited and would flow downward into the bilges. A wet and dripping submarine interior would be eliminated by the installation of a thin inner hull or lining, set at a distance of an inch or so from the outer hull and onto which cork insulation would be applied.

Odor Control a Difficult Problem

The diesel oil olfactory trademark of all submariners smells clean and is not objectionable — at least to the submariners. However, the closure of the submarine housing 75 to 100 men for periods of 12 to 18 hr, plus the aroma from oils, cooking, damp clothing and tobacco smoke — and augmented by the inevitable odor from the ship's sanitary tanks — results in a heavy atmosphere.

To avoid blowing to sea telltale refuse, submarines have been equipped with sanitary tanks in which are collected the ship's excreta, to be blown to sea at night or during periods which are otherwise safe from enemy detection.

Unavoidably, the tanks are vented to the interior of the ship. From these vents, odors inevitably arise — a condition greatly augmented by fluctuations of pressure within the ship incident to operations, particularly while snorkelling. During snorkelling the sanitary tank odor has been lessened by extending the vent piping to the engine room blowers so that air is exhausted by the engines. The most effective deodorant and actually the only substance which has been found to remove odors is activated charcoal, which is currently employed in baffled cylindrical filters installed on the sanitary tank vents.

Odor control in the submarine of the future is expected to prove to be a very difficult problem, despite the well-intentioned claims of those who would fill our submarines with deodorants allegedly deriving their effectiveness from various elements, but actually depending largely on an olfactory anesthetic and a masking perfume.

Color and Lighting Being Studied

In present submarines during extended snorkel patrols, and particularly in the submarine of tomorrow,

[Concluded on page 85]

Three Air Conditioning Systems To Serve Chrysler Building East

Dividing the air conditioning installation in three parts appeared to be the logical way of handling the new 32 story Chrysler Building East, in New York City, under construction adjacent to the existing 77 floor Chrysler Building

A METHOD OF AIR conditioning which may influence the design of systems for modern office buildings, particularly those in the 20 to 40 story height range, has been developed for the new Chrysler Building East in New York City by Guy B. Panero, engineers. Completion of the 32 story building is expected this fall.

The building was designed by Reinhard, Hofmeister & Walquist, architects; Edwards & Hjorth, structural engineers; and Guy B. Panero, mechanical engineers. The general contractor is the Turner Construction Co.

Actually, the building will have three different types of air conditioning systems — all planned to maintain a maximum of 80 F and 50 percent relative humidity when the outdoor dry bulb temperature is 95 F and the outdoor wet bulb is 75 F. During the heating season, the system is designed to maintain a dry bulb temperature of 72 F inside when the outside temperature is 0 F.

POSSIBLE FUTURE AIR CONDITIONING for the 77 story Chrysler Building is provided for in the new 32 floor Chrysler Building East, which has space for two 850 ton refrigeration compressors and provisions for 1700 tons of cooling tower capacity

The first system combines heating and cooling and is designed to take care of all outside space (approximately 16 ft back from the outside wall) from the second through the 32nd floors. This system employs window type air handling units and five medium or low pressure outside air preconditioning systems. The function of these systems is to furnish sufficient preconditioned outside air to provide a means of obtaining exact control of conditions in spaces having various exposures. This will be accomplished by cooling with preconditioned outside air where sun effect exists, and, at the same time, heating on other exposures by means of the window units.

The second system consists of conventional air conditioning to take care of all interior spaces from the second through the 32nd floors.

The third system serves the rentable spaces in the concourse and first floor. Outside air duct work and chilled water piping to the fan rooms will be installed first, and conventional air handling systems for the various stores and other spaces will be added later.

Internal air conditioning capacities are based on 3 watts per sq ft of floor area and 100 sq ft per person. The new building will contain about 400,000 sq ft of rentable space and a total area, including ground floor and basement, of 430,000 sq ft.

For the conventional air conditioning systems, the outside air quantities are based on a minimum of 25 percent of the total air handled. For interior systems during the intermediate seasons, half the air handled will be outside air. The outside air

intakes for the future systems on the concourse and first floors have been designed to handle up to 100 percent outside air during the intermediate seasons.

Logical Way To Meet Problem

Dividing the air conditioning into three parts is a logical way of meeting the problem, because each space requires a separate solution. The window units, equipped with individual fans, eliminate the need for radiators or convectors. These units also provide individual control for the outside rooms — where it is most needed. A third advantage is that duct sizes can be reduced by more than half, since the capacity is sized to handle only outside air.

The interior areas, relatively unaffected by sun or orientation, can be handled economically by a separate conventional system. The store areas on the lower "public" floors are generally not completely rented until a building is almost finished, and are best treated individually.

The "heart" of the system for conditioning peripheral spaces will be individual room conditioning units. One complete unit will be placed under each window, but a single cabinet will cover the entire space between columns, thus housing two units. Each unit will be equipped with an automatic valve so that it may be individually controlled if necessary. In large offices, however, one thermostat may control two to four units.

The entire air conditioning system will be regulated by pneumatic controls.

1400 Tons of Refrigeration

As with many large buildings in New York City, it was found to be economical to purchase steam from the New York Steam Corp. Steam will be brought into the building at 125 to 150 lb pressure and used at full pressure to run the steam turbines which drive the compressors.

The 1400 tons of refrigeration the building requires will be produced by two centrifugal compressors, using "Freon-11" as the refrigerant. Each unit is to produce 700 tons when cooling 1400 gpm from an initial temperature of 54 F to a terminal temperature of 42 F when the condenser is supplied with 2100 gpm of water at 85 F.

Each evaporator is designed for the circulation of 1400 gpm of water, with the pressure drop from inlet to outlet water not to exceed 25 ft.

The condensers are designed for the circulation of 2100 gpm each at an entering temperature of 85 F. The pressure drop from inlet to outlet, including the water box, is not to exceed 20 ft.

Each of three cooling towers will be able to cool 1400 gpm from 105 F to 85 F when the outdoor wet bulb temperature is 78.

Provisions for 77 Story Chrysler Building

The new Chrysler Building East was designed to accommodate cooling towers of 1700 tons capacity for the possible future air conditioning of the existing 77 story Chrysler Building. Space is also provided in the sub-cellar of the new building for the future installation of two 850 ton turbine driven compressors. This 1700 tons of refrigeration would comprise about 70 percent of the entire refrigeration load for the existing building.

Special care was taken to eliminate noise and vibration from the air conditioning system. Flexible hose will be installed at all pump suctions and discharges, and vibration isolators will be put under all machines with moving parts. The interior casings of the room units are acoustically treated for quiet operation.

NAVY AIR CONDITIONING —

[*Concluded from page 83*]

personnel will miss the stimulation — the psychological lift — of the morning of a new day, of night, of weather changes. With the ship continuously submerged, operations become vastly more routine and monotonous — to the point that boredom may intervene to the detriment of morale and effectiveness.

In an effort to combat the development of such a situation, study and experiment have been underway for the past three years through the use of color and materials toward removal of the submarine's coldly utilitarian aspect and substitution of an illusion of spaciousness, an atmosphere of relaxation, and to effect a sensation of change of pace and location in moving through various compartments. Concurrently, the woefully inadequate illumination — both in degree and distribution — is under study so that an effective, pleasant, non-glare lighting distributed according to operational needs and psychological acceptability may be developed. The attempt made is to attain the utmost in habitability within the limitations imposed by operational requirements.

How Far Can You Go?

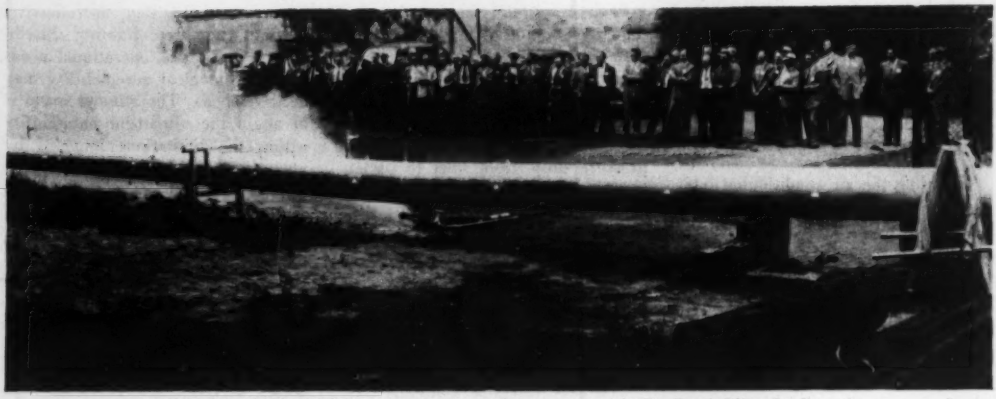
And in this attempt to strike a balance between habitability and operational efficiency, we enter a most difficult area of judgment. In the last analysis, the basic reason for more pleasant living, bettered working conditions, and for improved machines designed for and attuned to the anatomy, physiology and psychology of the operator is to improve efficiency, effectiveness and production. How far should planners, designers and administrators go in this program? Where is the point of diminishing returns?

An air conditioned battleship is pleasant and comfortable, the crew sleeps well and feels more rested, they like their duty assignments and feel that they are being well cared for — all this resulting in higher morale. All these factors have face validity in improving efficiency, effectiveness and production. But what has it cost in terms of the two critical factors of space and weight?

In the words of one of our top submarine constructors when it is proposed that an additional piece of equipment be included in a submarine design: "O.K., what do you want taken out?" At the cost of how many guns, how many rounds of ammunition, how much fuel oil, how much food, how many crewmen — the vital components of the fighting ship — can the full air conditioning program be effected?

The only really important question is whether or not the resultant fighting unit is more efficient, effective and productive. This question and its answer must be approached and decided ruthlessly. The problems of justification and the measurement of improved or lowered efficiency are ones which all of us realize are fraught with difficulty and for which few tenable criteria have been found.

The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval service at large.



CAUSES OF WATER HAMMER in steam piping are being investigated by The Detroit Edison Co. Slugs of water hitting end of line in this test set-up are believed to create pressures of 6000 to 7000 psi

District Heating Group Studies Piping and Heating Problems

By John F. Collins, Jr.
Secretary-Treasurer of NDHA

Water hammer in steam pipes, use of packless expansion joints, determining pressure gradients in loop distribution piping systems and construction of steam main extensions were among the problems discussed at the NDHA's annual meeting, which also gave considerable attention to statistics of the industry, its future prospects and how to reduce costs

THE ANNUAL STATISTICAL analysis of the district heating industry — the operating statistics report — was presented for 1950 at the 42nd annual meeting of the National District Heating Association by Foster L. Stephens, of the Allegheny County Steam Heating Co., Pittsburgh, the committee chairman.

Mr. Stephens reported that, on a weighted average basis, steam sales of the heating utilities increased 7.8 percent over 1949. Of 49 comparable utilities, 44 showed increases in sales and five showed decreases. Such an average increase was to be expected because the weather generally was colder; 51 companies showed an increase of 7.6 percent in the number of degree-days.

The total revenue of 49 comparable companies was $62,939,000, which on a weighted average basis was an increase of 10.3 percent. The ratio of fuel cost to revenue improved somewhat.

The average revenue or rate per 1000 lb of steam sold increased 2.2 percent, notwithstanding 23 companies reporting decreases. Colder weather resulted in a larger percentage of steam being sold in the lower rate blocks.

The increase in connected load amounted to 3.5 percent.

The fuel cost per million Btu showed little change from 1949 but the total hourly wage cost was up 5.35 percent, despite a small decrease in the number employed.

Capital investment increased 4.46 percent, and on the basis of square feet of external pipe surface, there was an increase of 1.8 percent in the amount of distribution mains and services.

Steam loss per square foot of distribution pipe surface — a loss of deep concern to the utilities — increased 7.8 percent during the year reported on.

Discussing new business for 1950 (as a part of the report of the sales development committee, of which Howard W. Harrison, Georgia Power Co., Atlanta, was chairman) Sterling S. Sanford, of The Detroit Edison Co., said that in 52 cities a total of 984 new customers had been connected in 1950. These, it was es-

timated, would require 2,422,000 M lb of steam annually and would bring in $2,771,000 in revenue. Of these 984 new contracts, 570 were for service in old buildings not previously served, 195 were for buildings served at some past time, and 219 were for new buildings.

Ninety-one new customers in New York accounted for 24 percent of the steam used by all new customers and 271 new customers in New York, Detroit, Philadelphia and St. Louis accounted for more than half of it. The largest group of new customers comprises stores and restaurants.

In seven cities, no new customers were connected at all in 1950. In 23 cities, 81 customers were lost.

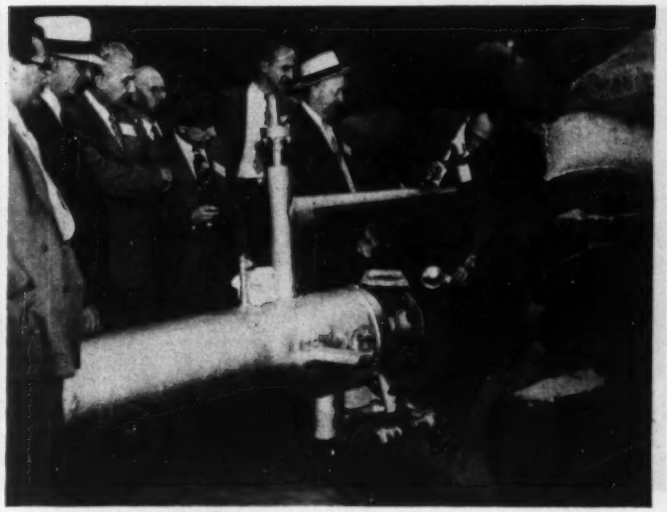
There is insufficient boiler capacity in 12 cities to serve new customers. In only one are there plans for additions in 1951. Limited capacity only is available in nine other cities. Eight companies added a total boiler capacity of 655,000 lb in 1950. Four plan to add 530,000 in 1951. In only one of six cities in which there is insufficient distribution facilities are there plans for additions. Twenty-five utilities made additions in 1950 and 18 plan to do so in 1951.

On the same committee program, Norman H. Davidson, of the Rochester (N.Y.) Gas and Electric Corp., brought out some new ideas on selective load selling. He proclaimed that there are few, if any, steam utilities that cannot take on some additional load even though their peaks are at or near their system capacity with proper reserves. Additional revenue can be produced without making a heavy outlay for additional plant. The load to be added, however, must be interruptible or it must be such that its peak does not coincide with the system peak. The contract between the customer and the utility must be quite clear so there is no doubt as to what will be done during peak loads.

The commercial relations committee — headed by Arthur T. Lukens, of the Philadelphia Electric Co. — presented several interesting papers.

The chairman described the equipment of both customer and utility required in Philadelphia for the utilization of steam service.

Percy A. Hyde (Ohio Edison Co., Akron) analyzed customer contacts, segregating them into four classifications: (1) Prospective customer calls on the utility for service. (2) Old customer calls on the utility for advice on changes or expansion. (3) Old customer calls to inquire regarding bills. (4) Utility calls on the customer to inspect, advise or arrange for special conditions.



WATER HAMMER DEMONSTRATION was given by Ernest T. Smith (right) at Detroit Edison's Beacon St. heating plant during NDHA annual meeting

The third paper was presented by F. Lee Rapson, of Baltimore. Mr. Rapson had collected data concerning the physical dimensions, heating systems and space heating steam use of apartment buildings, church buildings, club houses, commercial buildings, department stores, hotels, loft buildings, public buildings and theaters in many cities. He showed that space heating steam-use estimates based on the exposed area in any building classification will be more likely to be accurate than such estimates based on the heated volume.

A preliminary draft of a code for condensate metering was recently prepared by the metering committee, under the leadership of William G. Gillim of the New York Steam Corp. As a preliminary step to the preparation of a complementary code on steam flow metering, three representatives of meter manufacturers — R. E. Sprenkle, Bailey Meter Co.; E. R. Loud, Builders-Providence, Inc.; and J. B. Mahon, Republic Flow Meters Co. — gave papers describing their respective meters, their operation and their maintenance.

Steam rate conditions are more stable than two years ago, according to the report of the rates and regulations committee presented by its chairman, Clifford O. Thurlow, Commonwealth Services, Inc., Jackson, Mich. Mr. Thurlow said that of 148 rates examined, in only 11 cases was the base raised and in only one instance was it lowered during the past year.

Speaking of fuel clauses, which are a part of many rates and which compensate steam utilities for changes in fuel cost which are beyond their control, Mr. Thurlow said that where comparisons were possible it had been found that 52 percent of the fuel clauses had been decreased an average of 12 percent and 28 percent of such clauses had been increased an average of 22.5 percent during 1950.

Fuel clauses were found in use by 77 of 98 utilities, labor clauses by only two and tax clauses by only six. Clauses other than those having to do with fuel cost are minor, are on items controlled to some extent by the utility and are of little value.

For the steam station engineering program, of which George F. Prestwich, Philadelphia Electric Co., was chairman, R. G. Felger, The Detroit Edison Co., had two papers.

In the first of these, on stack emission, he described some of the methods used by the central heating

NDHA OFFICERS and committee chairmen for 1951-52

Rear row—Committee Chairmen Walter M. Gillespie, Arthur T. Lukens, William G. Gillim, Ernest E. Dubry, Clifford O. Thurlow, Foster L. Stephens, Norman H. Davidson, Julius J. Schenk, George K. Saurwein, Leo F. Collins, and Secretary-Treasurer John F. Collins, Jr.

Front row—Directors Vernon J. Suche, Fred W. Deutsch and Norman W. Calvert, Third Vice-President Thomas P. Brown, Jr., Second Vice-President Charles W. Deeg, President Alfred T. Veness, First Vice-President Percy A. Hyde, Past President George H. Tuttle, and Directors Lee C. Killen and Edward J. Flahie.

department to eliminate smoke. Mr. Felger said that three recent developments seem certain to make the problem of stack emission inescapable to district heating plants. These are: (1) The growth of tall buildings in areas surrounding such plants. (2) Increased interest in "pure air". (3) An increasing necessity to use coals high in ash and volatile matter. He said that "it has been shown that in minimizing smoke, acceptable results can be accomplished merely by installing smoke preventive consciousness into plant operators, but that in minimizing fly ash, well designed collecting equipment is mandatory."

In his second paper Mr. Felger told of changes made in the steam generating equipment at the Willis Ave. plant of his company, increasing its capacity by 50,000 lb per hr of steam and improving reliability. The changes consisted of the addition of water walls and a new stoker and the rebuilding of the setting.

Investigate Packless Expansion Joints

John C. Haroldson, Duluth Steam Corp., and Harvey J. Bell, Southern Indiana Gas and Electric Co., Evansville, reported the results of an investigation of the reliability and desirability of corrugated type packless expansion joints. Their information was obtained from 12 companies which had in use 5154 such joints, furnished by five manufacturers, from 3 to 24 in. diameter and having an average age of 19½ years.

The authors reached the conclusion that such joints are highly reliable, as indicated by a percentage of failures of only 1.5 — and these largely attributable to installations contrary to manufacturers' specifications. The authors pointed out that the ever rising cost of manhole construction and maintenance made this type of joint increasingly desirable from an economic standpoint.

Using Calculating Table for Flow in Piping

The determination of pressure gradients in a loop type district steam system is a rather laborious proposition using analytical methods, but in any program of steam main installation it is necessary that system pressure gradients be known in order properly to size the mains. In view of the very wide use which the electrical analogy method of solution of various types of mechanical problems has had, it was felt that it might be possible to express the flow-pressure drop formulas in electrical terms, thereby permitting a relatively rapid and simple method of pressure gradient determination.

A study was made by Homer F. Hatfield and Robert H. Swoyer, Pennsylvania Power & Light Co., Allentown, owner of a d-c calculating table, to determine if a technique could be evolved for solving the problem by using the table.

They reported the following conclusions:

1) The formulas cannot be made directly analogous to the relation utilized in the d-c calculating table.

2) The table cannot be used for determining directly the flow-pressure gradients in a loop type steam system.

3) After gradients in a loop type steam system have been assumed as is done analytically, the assumptions may be checked on a d-c table, but the time required to make this comparison equals or exceeds the analytical check.

However, as a result of the study, the authors were able to present several tables of flow factors and standard forms which permit determining pipe line velocity and pressure drop analytically with a minimum of calculation.

A steam main extension was made a year ago in Washington from the Pentagon to Federal Office Building No. 2. Roger E. Needham, of S. E. Dockstader Inc., described the new line, estimated the savings resulting from the use of insulating concrete,

[*Concluded on page 95*]

Kansas City—A Quick Mop-Up

More than 100 Kansas City area business and industrial firms, whose products range from biscuits to big machinery, were back in permanent offices and plants just three weeks after the height of the big flood, and more than 23,000 workers were by then back on jobs that had been washed out. By the first week in August, nearly 90 percent of railroad passenger trains were operating, and all airline flights were back to normal schedules. The plants of two well known manufacturers are shown here at the height of the flood.

The first floors of all seven Kansas City, Mo., plants of Gustin-Bacon Mfg. Co. were inundated by the rampaging waters, but fortunately, finished goods inventories had been stored on higher floors. Early last month all plants were in limited or full production, and carloads of the company's insulation were being shipped daily.

Three weeks after being inundated by the flood, Marley Co., Inc., Kansas City, Kans., was producing cooling towers and mechanical equipment at its home plant. The company was fortunate in that water did not reach the executive offices and engineering departments. All drawings, plans, and records were undamaged, though there was 8 ft of water in the plant.

HOW TO SPACE SUPPORTS for Large Diameter Thin Wall Pipe

By Theodore E. Bridge

Mr. Bridge recently has made a rather serious study of buckling of large diameter thin wall pipe, and this excellent article results from this work, which was undertaken in connection with some 72 in. diameter, 5/16 in. wall piping for a steel mill — a line crossing a number of railroad tracks. Very little has been published on this subject, which is of interest not only in piping design and installation but also pertains to long spans for fume or ventilating ducts

IT IS THE objective to present here an easy way to figure the maximum allowable spacing between supports for large diameter thin wall pipe. This problem can become quite complicated, as will be seen later. By following closely the calculation form that we have developed, we think that you will save a lot of calculating time. You will also be sure that all of the factors have been taken into account.

It is not suggested that you always try to space supports at the design limit; but there will be times, when crossing roadways and railroad tracks, that you may want to know just how far you can go. We think you will find this article useful for those problems that require the maximum possible spacing of supports.

In a previous article, How to Space Pipe Supports, published in HPAC October through December 1949, and February 1950, the author presented a method of calculating the spacing of supports for normal piping. That method was based on consideration of slope and stress. In spacing supports for large diameter thin wall pipe, we will have to think about slope and stress as before; but we will also have to think about buckling.

Buckling in the wall of a pipe is similar to buckling in a column. If a column is too slender, it will bend under load. There comes a time, as the load is increased, when the column will collapse altogether. The load at which the column will collapse is called the critical load. So also, if a thin pipe wall is subjected to too much compression, it too will collapse — resulting in a fold in the pipe. This type of failure can usually occur only when the pipe is not under pressure. Pressure in the pipe will hold the shell taut and prevent buckling.

Ring Girder Stiffens Pipe

Buckling is most likely to occur directly over a support. We can, if we wish, provide extra stiffness at this point by forming a ring girder around the pipe, as shown in Fig. 2. This will enable us to space the supports much farther apart. The ring stiffens the pipe wall to prevent a fold from starting, and it also distributes the load into the pipe. Herman Schorer, in his paper on Design of Large Pipe Lines, published in the transactions of the American Society of Civil Engineers (vol. 98, 1933) shows us how to calculate the dimensions of a ring girder that will prevent buckling. He also gives formulas for evaluating stress concentrations in the wall of the pipe near the ring. From his formulas, we have developed others in Appendix I. These are used in the examples which follow to calculate the spacing of supports for four typical problems.

The source of all formulas used in solving these examples is given in Appendix I. In Appendix II we give a semi-rational development of a formula that enables us to predict when buckling might occur in the middle of the span. The alignment chart in Fig. 1 has been prepared to speed the calculation of stress and slope, and also to show what thickness is required to prevent buckling in the middle of the span.

Examples Show Calculation Method

Four illustrative examples are given in Table 1 which show how to calculate the maximum spacing of supports for large diameter thin wall pipe. We have made the calculation in tabular form with a separate column for each example. Each row in the tabulation represents one simple operation to be performed. The right hand column gives the formula to be solved for each step. You will save a lot of time in making the calculation if you will follow closely this form. You will also be sure that all points have been considered.

The calculation form used in solving these examples applies only to steel piping. You must refer to the

Mr. Bridge acquired a wide experience in the design of power and process piping during 15 years with E. I. du Pont de Nemours & Co., and has also had experience in the field of very high pressures. He is now associated with United Engineers & Constructors, Inc. He has written a number of articles which have been published in HPAC, including an extensive series on how to space pipe supports. His most recent HPAC articles have been on the subject of piping flexibility, and on figuring tank supports.

source of the formulas given in the appendix if you wish to use them for materials other than steel.

Example No. 1 is a 54 in. OD gas line with a wall thickness of ⅛ in. and no allowance for corrosion. The design pressure in the pipe is 15 psi and the line might become flooded with water. A separate calculation showed that the thermal expansion bending stress in a horizontal plane was Sx = 3150 psi.

Example No. 2 is a 54 in. OD coke oven gas line with 5/16 in. minimum wall, and ⅛ in. allowance for corrosion having a net corroded minimum wall of 0.187 in. The design pressure is 15 psi. The line can never be flooded with water, but it is possible for 3 in. of liquid to collect in the bottom of the pipe. A separate calculation showed that the thermal expansion stress in a horizontal plane was Sx = 3150 psi.

Example No. 3 is the one used by Schorer in his ASCE paper on Design of Large Pipe Lines. In solving this example, we have used Schorer's value of L = 60 ft to check our method against his calculation. Our chart, Fig. 1, indicates buckling might be possible, and we calculate a higher stress than he. He must have used the maximum stress theory and employed expansion joints to absorb thermal expansion.

TABLE 1 — FOUR EXAMPLES illustrate how to calculate maximum spacing of supports for large diameter thin wall pipe

EXAMPLE NO. →	*1*	*2*	*3*	*4*	*Formula*
Design pressure, psi	15	15	43.5	40	P
Mean diameter of pipe, in.	53.9	53.7	120	132	D
Nominal thickness of pipe wall, in.	0.125	0.3125	0.25	0.25	t'
Corroded minimum wall thickness of pipe, in.	0.125	0.187	0.25	0.25	t
Thickness ratio, percent	0.232	0.348*	0.208	0.19	$B = 100\ t\ /\ D$
Wind load (20 lb per sq ft proj. area) lb/ft	90	90	200	220	$W' = 1.67\ D$
Weight of bare empty pipe, lb/ft	72	108	321	353	$W = 10.7\ D\ t$
Weight of water in pipe, lb/ft	990	20**	4900	5900	$Wc = 0.34\ D^2$
Weight of corroded metal, lb/ft	—	72	—	—	$Wm = W\ (t' - t)\ /\ t$
Total weight of pipe, lb/ft	1062	200	5221	6253	$W'' = W + Wc + Wm$
Draw a straight line on Fig. 1. Make this line intersect known values at D-scale	Nil	0.08	Nil	Nil	Z (see Fig. 1)
	Nil	0.22	Nil	Nil	Z' (see Fig. 1)
and B-scale,* for first two examples, and	34	105	60	41	L (see Fig. 1)
at D-scale and L-scale for last two examples. Read and tabulate intersections	28	85	49	34	L' (see Fig. 1)
with other scales.	300	2600	400	175	S (see Fig. 1)
Corrected dead weight bending stress, psi	4410	4800	6510	3100	$S'' = S\ W''\ /\ W$
Vertical thermal expansion bending stress	—	—	—	—	Sy (sep. calc.)
Total vertical bending stress, psi	4410	4800	6510	3100	$Sv = S'' + Sy$
Wind load bending stress, psi	375	2160	249	109	$Sw = S\ W'\ /\ W$
Hor. thermal expansion bending stress, psi	3150	3150	—	—	Sx (sep. calc.)
Total horizontal bending stress, psi	3525	5310	249	109	$Sh = Sw + Sx$
Resultant bending stress, psi	5650	7160	6510	3100	$Sb = (Sv^2 + Sh^2)^{\frac{1}{2}}$
Solve Equation 79 to obtain the required section modulus of support stiffening rings, in.³	1.42	0.824	27.4	24.8	$Q = 73\ W''\ L\ D\ /\ 10^6$
Pick two angles with required sec. modulus	3x3x⅜	3x3x¼	1x12.25	8x8x¾	(steel tables)
Weight of each angle, lb/ft	7.2	4.9	†	38.9	(steel tables)
Area of both angles, sq in.	4.2	2.88	12.25	22.8	A (steel tbls.)
No stiffening rings needed if Q is less than	0.28	0.625	2.5	2.75	$D\ t^2\ /\ 3$ (Eq. 80)
Width of stiffening rings (see Fig. 2), in.	6.375	6.25	1	16.75	C .....(1
	33.76	15.4	49	91.5	$Ra = A\ /\ t$ .....(2
	27.39	9.1	48	74.75	(2) — (1) .....(3
	2.84	3.5	6.06	6.35	$(D\ t\ /\ 0.82)^{\frac{1}{2}}$ .....(4
	36.6	18.9	55.06	97.85	(2) + (4) .....(5
	2.72	1.75	3.24	2.78	3.64 (3) / (5) ....(6
	3.72	2.75	4.24	3.78	1 + (6) .....(7††
	1615	1072	5220	5280	$P\ D\ /\ 4\ t$ .....(8
	6,000	2,960	22,100	20,000	(7) × (8) .....(9
	5,650	7,160	6,510	3,100	Sb (see above)
Solve Eq. 84 for equiv. stress	11,650	10,120	28,610	23,100	$Se = Sb$ + (9)
ASTM material spec.	A134	A134	A285	A285	
Stress allowed by code	11,000	11,000	11,000	11,000	Sc
Pipe thickness at support	0.133	0.1875	0.650	0.525	$t'' = t\ Se\ /\ Sc$

*When solving Example No. 2, in Fig. 1, B'=0.348 as pipe is always empty.
**Water is assumed 3 in. deep in bottom of pipe.

†Mr. Schorer selected a 1 x 12.5 rectangular section for this example.

††If expansion joints are to be provided in the pipe, the equivalent stress will be higher: (7)=2+(6). See appendix for explanation (Equation 84a).

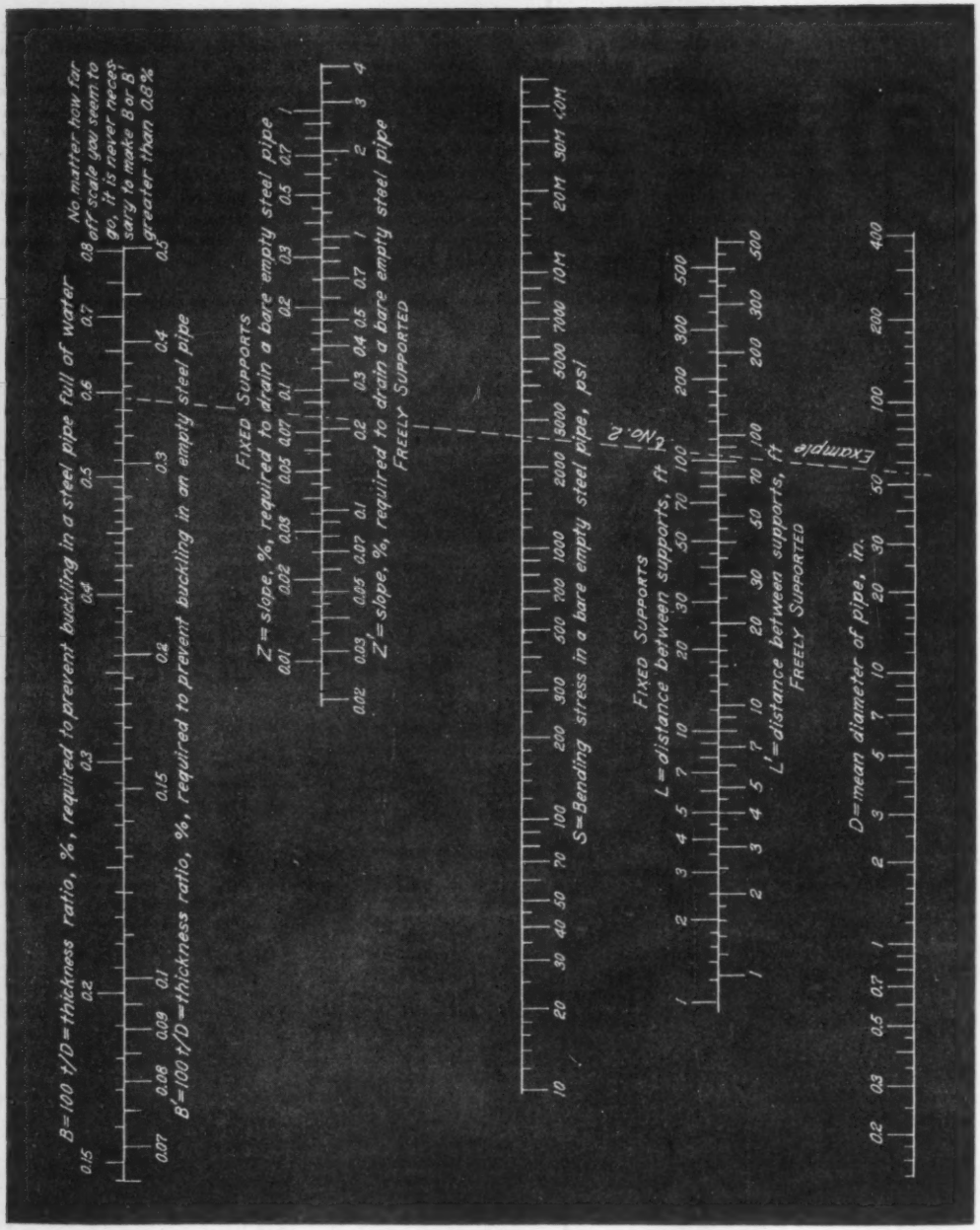

B=100 t/D=thickness ratio, %, required to prevent buckling in a steel pipe full of water
B'=100 t/D=thickness ratio, %, required to prevent buckling in an empty steel pipe
No matter how far off scale you seem to go, it is never necessary to make B or B' greater than 0.8%
Fixed Supports
Z=slope, %, required to drain a bare empty steel pipe
Z'=slope, %, required to drain a bare empty steel pipe
Freely Supported
S=Bending stress in a bare empty steel pipe, psi
No. 1
No. 2
Fixed Supports
L=distance between supports, ft
L'=distance between supports, ft
Freely Supported
Example
D=mean diameter of pipe, in.

FIG. 1—CHART FOR FIGURING bending stress and slope to drain a bare empty steel pipe. Multiply chart values by the ratio of actual weight to bare empty weight to obtain corrected stress and slope. The thickness ratio to prevent buckling is also given for pipes both empty and full of water

Example No. 4 is the Kungfors line which was built in 1921 and is described on page 102 of Schorer's paper referred to above. In solving this example we have used the as-built value of $L = 40$ ft, and we assumed the pressure in the line to be $P = 40$ psi. The details of the stiffening rings were not given in the reference.

Fixed and Free Spans

The chart in Fig. 1 shows the allowable length for both fixed spans (L) and free spans (L'). In a previous article, the author demonstrated that all spans may be considered as fixed, except as follows:

1) The end span in a long line of supports must be considered to be freely supported.

2) The span next to a welding elbow (looking either up or down) must also be considered to be freely supported. Flattening effect in the elbow makes it act like a hinge.

3) If the pipe is made to overhang the end span by an amount equal to (0.41 L), it too may be considered as fixed. Negative bending moment produced by the overhang simulates a fixed beam.

Appendix I — Source of Formulas Used

The source of all equations, 1 through 76, is given in a previous article by the author, How to Space Pipe Supports, published in HPAC, October through December 1949.

The following equations were used in constructing the alignment chart in Fig. 1.

$$Z = 0.000217\ L^3 / D^2 \quad \text{.....[12]}$$
$$Z' = 0.00112\ (L')^3 / D^2 \quad \text{.....[21]}$$
$$S = 13.6\ L^3 / D \quad \text{.....[61]}$$
$$S = 20.4\ (L')^3 / D \quad \text{.....[66]}$$

All symbols are defined on the chart in Fig. 1.

Ring girder supports are required for supporting large diameter thin wall pipe to prevent buckling of the pipe at the support. A formula is needed to calculate the section modulus Q (in.^{3}) of the ring girder section. After having calculated the section modulus, you may refer to any of the standard tables published by the steel companies to select a pair of angles having the required section. The angles are to be formed around the pipe at the support, as shown in Fig. 2.

Schorer, in his ASCE paper on Design of Large Pipe Lines, published in the transactions of the ASCE, vol 98, gives in his Fig. 7 the following formula for calculating the bending moment in the ring girder:

$$(2\ Mr\ /\ W''\ L\ D) = 0.0146$$

where L is the length between supports, ft; D is the mean diameter of the pipe, in.; W'' is the total weight of the pipe, lb/ft; Mr is the bending moment in the ring girder, in lb. (It is assumed that the center of the uprights in Fig. 2 lines up with the center of the ring.)

The above formula can be transposed to give:

$$Mr = 0.0073\ W''\ L\ D \quad \text{.....[77]}$$

The allowable stress in the steel ring girder may be taken as 10,000 psi, and is given by the common beam formula:

$$Sr = 10{,}000 = Mr\ /\ Q \quad \text{.....[78]}$$

where Q is the section modulus of the ring girder, in.^{3}

Substitute [77] in [78]:

$$Sr = 10{,}000 = 0.0073\ W''\ L\ D\ /\ Q$$

and

$$Q = 73\ W''\ L\ D\ /\ 10^6 \quad \text{.....[79]}$$

A pair of angles are to be wrapped around the pipe at the support as shown in Fig. 2. They are to have a combined section modulus at least equal to Q as calculated above.

If the pipe wall is thick enough, no ring girder is needed. It is estimated that we can usually consider the support reactions to be distributed through a length of pipe about two diameters long. This means that, if the section modulus of a rectangle two diameters wide and t inches thick is greater than Q, no stiffening rings are required.

The above statement may be expressed in symbols as follows. Ring girder supports are not required if Q is equal to or less than:

$$D\ t^2 / 3 \quad \text{.....[80]}$$

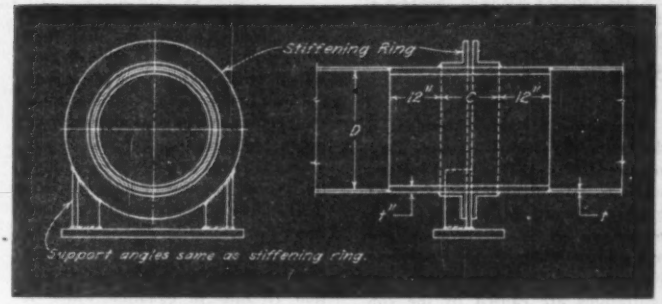


FIG. 2 — DETAIL OF STIFFENING RINGS that are to be provided at the support

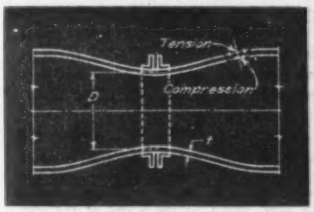


FIG. 3 — STIFFENING RINGS set up in the pipe itself stress concentrations that will add to other stresses caused by pressure and bending, as indicated in this exaggerated view

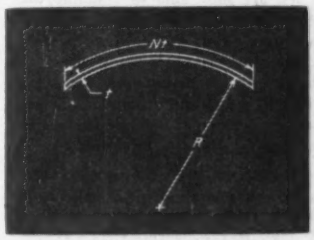


FIG. 4 — SECTION THROUGH the column formed by the plate between the two imaginary slots

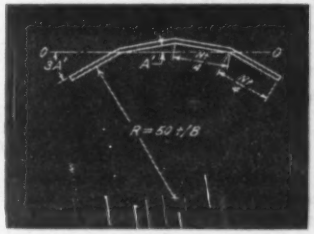


FIG. 5 — HOW COLUMN SECTION of Fig. 4 may be approximated by four equal chords

t is the corroded minimum thickness of the pipe and D is the mean diameter of the pipe.

Stress in the Pipe

The above formulas are used to determine the size of stiffening rings required to prevent buckling at the supports. If stiffening rings are used, however, they will set up, in the pipe itself, stress concentrations that will add to other stresses caused by pressure and bending. These concentrations are caused by the constriction produced by the ring as pressure is applied to the pipe. Fig. 3 shows this condition exaggerated to aid in visualizing the stress.

Schorer, on page 110 of the above mentioned reference, gives a formula for evaluating the concentration produced by the ring:

$$Sa' = 1.82\ (Ra - C)\ Sp\ /\ [Ra + (D\ t/0.82)^{\frac{1}{2}}] \quad \ldots\ldots[81]$$

Ra is the ratio A/t, where A is the area of the ring girder section, sq in., and t is the corroded minimum wall thickness of the pipe, in.; C is the width of the ring girder, in. (see Fig. 2); D is the mean diameter of the pipe, in.; Sp is the hoop stress in the pipe, psi (for thin wall pipe, $Sp = P\ D\ /\ 2\ t$); Sa' is the axial stress concentration produced by the constriction of the ring as pressure is applied to the pipe.

We are now able to combine the above stress with the other stresses in the pipe. For single plane piping, where there is no twisting stress in the pipe, the equivalent stress is given by Equations 74 and 75. These may be written to include the above stress Sa'. Rewrite Equation 74:

$$Se = Sa - Sb - Sp - Sa' \quad \ldots[82]$$

Se is the equivalent stress which is a measure of the combined effect of all of the other stresses acting together, psi; Sa is the axial pressure stress, psi ($Sa = P\ D/4\ t$); Sb is the combined bending stress, psi (it is equal to the vector sum of the bending components acting in the horizontal and vertical plane); Sp and Sa' are both defined above.

For thin wall pipe:

$$Sa = Sp\ /\ 2 \quad \ldots\ldots[83]$$

Substitute Equations 81 and 83 in 82:

$$-Se' = Sb - Sp/2 + Sp + [1.82\ Sp\ (Ra - C)]\ /\ [Ra + (D\ t/0.82)^{\frac{1}{2}}]$$

$$-Se = Sb + \{1 + [(Ra - C)\ 3.64]\ /\ [Ra + (D\ t/0.82)^{\frac{1}{2}}]\}\ Sp/2 \quad \ldots\ldots[84]$$

If expansion joints are installed in the pipe so that the longitudinal pressure stress (Sa) is zero, then the equivalent stress, by the maximum shear theory, will be greater than given by Equation 84.

$$-Se = Sb + \{2 + [(Ra - C)\ 3.64]\ /\ [Ra + (D\ t/0.82)^{\frac{1}{2}}]\}\ Sp/2 \quad \ldots\ldots[84a]$$

Equation 84 above was developed from Equation 74. It gives the resultant stress acting in a plane with the wall of the pipe at a point where the bending stress is producing maximum compression. Equation 75 gives the stress in a plane containing the axis of the pipe at a point where the bending stress is producing maximum tension. If we neglect the radial stress, which is very small for thin wall pipe, we may resolve Equation 75 into an equation which is identical to Equation 84; except that it has the opposite sign, indicating tension instead of compression.

Appendix II — Wall Thickness to Prevent Buckling

We will now develop a semi-rational formula for calculating the pipe thickness required to prevent buckling in the middle of the span. This development will be based on fixed spans of length (L). A similar analysis would give a slightly different formula for free spans of length (L'). The chart in Fig. 1 will give the approximately correct answer for either type of span.

The bending moment in the middle of a fixed span is given by the formula:

$$Mi = Wi\ Li^2\ /\ 24 \quad \ldots\ldots[85]$$

Mi is the bending moment, in.-lb; Li is the distance between supports, in.; Wi is the weight of pipe and contents, lb/in.

$$Wi = s\ d\ \pi\ D\ t + d\ \pi\ D^2\ /\ 4$$

D is the diameter of the pipe, in.; t is the wall thickness of the pipe, in.; d is the density of the fluid in the pipe, lb/cu in. (for water, $d = 0.0362$); s is the density of the material in the shell divided by the density of the fluid in the pipe (for a steel pipe filled with water, $s = 7.8$).

$$Wi = \pi\ D^2\ d\ (s\ t\ /\ D + 0.25)$$

Let

$$B = 100\ t\ /\ D \quad \ldots\ldots[86]$$

$$Wi = (0.04\ s\ B + 1)\ \pi\ D^2\ d\ /\ 4 \quad \ldots\ldots[87]$$

Substitute [87] in [85]:

$$Mi = (0.04\ s\ B + 1)\ \pi\ D^2\ Li^2\ d/96 \quad \ldots\ldots[88]$$

The stress from bending in a beam is:

$$S = Mi\ D\ /\ 2\ I \quad \ldots\ldots[89]$$

S is the bending stress in the pipe, psi; I is the moment of inertia of the pipe section, in.^{4}

$$I = \pi\ D^3\ t\ /\ 8 \quad \ldots\ldots[90]$$

Substitute [90] and [88] in [89]:

$$S = (0.04\ s\ B + 1)\ \pi\ D^3\ Li^2\ d \times 8/2 \times 96\ \pi\ D^3\ t$$

$$S = (0.04\ s\ B + 1)\ Li^2\ d\ /\ 24\ t \quad \ldots\ldots[91]$$

The above formula gives the compressive stress in the top fibers of the middle section of a fixed span. This compressive stress would tend to buckle a very thin plate.

We may assume that longitudinal slots are cut in the top of the pipe an arbitrary distance apart. Let this distance be equal to ($N\ t$), and use the Euler formula to calculate the critical load on the column formed by the section of pipe between the imaginary slots. We will assume that the column has fixed ends as each span tends to buckle the same way — downward. Also, only the middle section of the column is under full compressive loading.

P is the load on the column, lb:

$$P = (\text{stress} \times \text{area}) = S\ N\ t^2 \quad \ldots\ldots[92]$$

Substitute [91] in [92]:

$$P = N\ (0.04\ s\ B + 1)\ Li^2\ d\ t\ /\ 24 \quad \ldots\ldots[93]$$

The Euler formula for calculating the critical load on a column with fixed ends is:

$$Pc = 4\ \pi^2\ E\ I'\ /\ Li^2 = 2\ P \quad \ldots[94]$$

E is Young's modulus of elasticity for the material in the pipe, psi; I' is the moment of inertia on a section through the column, in.^{4}; Pc is the critical load on the column, lb, and it should be made equal to $2P$ to apply a factor of safety of two.

From Equations 93 and 94:

$$2\ P = N\ (0.04\ s\ B + 1)\ Li^2\ d\ t\ /\ 12 = 4\pi^2\ E\ I'\ /\ Li^2$$

$$N\ (0.04\ s\ B + 1)\ Li^2\ d\ t = 48\ \pi^2\ E\ I' \quad \ldots\ldots[95]$$

Fig. 4 shows a section through the column formed by the plate between the two imaginary slots.

Fig. 5 shows how the column section of Fig. 4 may be approximated by four equal chords.

$$A' = N\ t\ /\ 8\ R = N\ B\ /\ 400 \quad \text{(radians)} \quad \ldots\ldots[96]$$

The moment of inertia of the section shown in Fig. 5, about axis 0 — 0, is given approximately by the following formula:

$$I' = (N t^4/12) + 2\,(N/4)^3\, t^4\,(2/3)^2\,(\sin^2 A' + \sin^2 3A')$$
$$I' = (N t^4/12)\,[1 + (\sin^2 A' + \sin^2 3A')\,N^2/6] \quad \ldots\ldots [97]$$

Substitute [97] in [95]:

$$Li^4 = \{(4\pi^2\, E\, t^2)\,[1 + (\sin^2 A' + \sin^2 3A')\,N^2/6]\} / [d\,(0.04\, s\, B + 1)] \quad \ldots [98]$$

Substitute [86] in [98]:

$$Li^3 = \{4\pi^2\, E\, D^2\, B^2\,[1 + (\sin^2 A' + \sin^2 3A')\,N^2/6]\} / [d\,(0.04\, s\, B + 1)\,1{,}000{,}000] \quad \ldots\ldots [99]$$

For a steel pipe full of water, E is 29 x 10^6, d is 0.0362, s is 7.8 and π^2 is 9.88.

The span required for a 72 in. diameter by ¼ in. wall pipe was calculated with Equation 100 using

$$(Li/423)^4 = \{D^2\, B^2\,[1 + (\sin^2 A' + \sin^2 3A')\,N^2/6]\} / (0.312\, B + 1)\,10^6 \quad [100]$$

When we use Equation 100 in an actual design problem, we must assign an arbitrary value for N, the ratio of distance between imaginary slots to the thickness of the pipe. We find (from Table 61, in the Handbook of Welded Steel Pipe, published by Calco Div. of Armco Drainage and Metal Products, Inc., Los Angeles, 1947) that a pipe 72 in. in diameter with ¼ in. wall is recommended for supports 72 ft apart. Since this table is in common use, it is believed to be safe.

several values for N. The results are:

N	120	150	180	
Li (in.)	579	725	852	
L (ft)	47.2	60.5	71	fixed
L' (ft)	35.9	46	54	free

We find from this that we get the same answer as the Handbook of Welded Steel Pipe if we let N = 180.

Substitute N = 180, $L = Li/12$ and Equation 96 into Equation 100 to obtain:

$$(L/35.2)^4 = \{D^2\, B^2\,[1 + (\sin^2 0.45\, B + \sin^2 1.35\, B)\,5400]\} / [(0.312\, B + 1)\,1{,}000{,}000] \quad \ldots\ldots [101]$$

A similar study for a free span would produce the following formula:

$$(L'/26.8)^4 = \{D^2\, B^2\,[1 + (\sin^2 0.45\, B + \sin^2 1.35\, B)\,5400]\} / (0.312\, B + 1)\,1{,}000{,}000 \quad \ldots\ldots [102]$$

If we wish to calculate the maximum span for an empty pipe, we may use the same equations by dropping the 1 from the denominator, which then becomes (312,000 B).

The alignment chart in Fig. 1 has been designed to solve Equation 101. It will give an approximate solution to Equation 102. It also shows thickness ratio required for an empty steel pipe (denominator of Equation 101 equal to 312,000B).

DISTRICT HEATING —

[Concluded from page 88]

gave unit and total cost figures and showed the results of a year-long heat loss test.

The Ohio Edison Co. has completed construction in Akron of an 800 ft section of a 16 in. tie-line to improve pressure conditions on its steam system. Percy A. Hyde described the new line and the operating improvements resulting from its use.

Construction features of an 11,500 ft extension of a 16 in. steam line to provide duplicate service lines to the Henry Ford hospital in Detroit were described by W. D. McCully, The Detroit Edison Co.

Study Water Hammer in Steam Pipes

Following several serious experiences with flooded steam lines, Detroit Edison in 1949 began experiments to determine if possible what causes water hammer in steam pipes, what conditions accompany it, and what can be done to prevent it. E. T. Smith and E. E. Dubry related their experiences. They said that they could report no factual engineering data at the time. The damage done to the 60 ft long 16 in. pipe, welds, anchors and fittings indicated a terrific force during the tests and they attributed the action to slugs of water hitting the end of the line creating pressures of 6000 to 7000 psi there.

On the steam losses committee program, chairman Robert L. Fitzgerald, Duluth Steam Corp., said that members of his committee and others continue to be of the opinion that metering deficiencies are closely allied to steam losses and recommended a closer tie between the steam losses and the metering committees.

W. W. Stevenson, Allegheny County Steam Heating Co., Pittsburgh, described a laboratory test of superheated steam flow in which temperatures were taken as an index to heat losses from the steam piping. He said the results showed that the reduction in heat loss from the pipe due to superheat is relatively small when piping is well insulated.

The advisory committee had several assignments during 1950. Past President Roy M. McQuitty, of the Union Electric Co. of Missouri, St. Louis, its chairman, advised that the proposed condensate metering and steam metering codes be incorporated into one document. He said his committee would have to study further before defining the scope of each technical committee.

The responsibility for preparing the third edition of the District Heating Handbook for publication was that of the educational committee, of which J. Earl Seiter, Consolidated Gas Electric Light and Power Co. of Baltimore, is chairman. Chairman Seiter reviewed the five year program of his committee, which had just ended with the completion and distribution of the volume. Production of the book had, over the last 2½ years, taken 50 percent of the time of the NDHA headquarters staff, necessitating delay in editing the proceedings for 1949 and 1950.

Chairman E. E. Dubry, of the past president's committee, proposed a number of problems for future study. These are: (1) How to improve steam plant design. (2) How to reduce investment. (3) How to reduce operating cost. (4) How to increase earnings. (5) How to increase load factor. (6) How to secure better information on business trends.

[Other information presented at the NDHA's annual meeting was summarized in the July HPAC.]

Radiation Screens Improve Work Conditions in "Hot Spots"

By George F. Haines, Jr.
Chemical Engineer
Industrial Hygiene Foundation, Mellon Institute

One of the most neglected of industrial "contaminants" is unwanted radiant heat from process equipment. While general ventilation is often the answer to convectional heat, it is of little value against radiant heat. Screening, however, may be readily applied to improve work conditions in hot industries, as described in this helpful and practical article

UNWANTED RADIANT HEAT is undoubtedly one of the most neglected of industrial "contaminants." Many industries are plagued year in and year out with extreme heat exposures, yet in their application of control measures they fail to control the major contributor to discomfort. The fact that the radiation from "hot" operations is fairly constant the year 'round is all the more reason to control it.

In planning an effective heat control program, it is first of all necessary to evaluate the heat exposures in respect to the relative contributions of radiation and convection to the total heat load imposed on man. It must be remembered that, with normal convection, approximately two-thirds of the heat lost from hot surfaces to the environment is by radiation and only one-third is by convection. In controlling industrial heat exposures, each of these modes of heat transfer must be evaluated separately — since entirely different measures are required for their control.

If convectional heat — "hot air" — is the major offender, then general ventilation will, in many instances, provide an acceptable working environment. Against radiant heat, however, ventilation is of little value and an entirely different control procedure must be followed.

The results of actual evaluations of heat exposures in a hot industry are presented in Table 1. It should be noted that, in these 11 heat exposures, radiation was responsible for about 50 to 75 percent of the total heat load imposed upon the men, while convection contributed only approximately 5 to 25 percent to the total heat load. It is logical from such an evaluation to plan a radiant heat control program.

Control by Screening Is Practical

Radiant heat is transmitted through space by wave motion, the intensity and wave length distribution depending on the nature and temperature of the surface. This heat can only be controlled by insulating or screening and not by general ventilation; in fact, it is quite common to find air temperatures of 75 to 85 F in working areas around furnaces, yet the environments are unbearable because of the intense radiant heat.

Screening, besides being relatively inexpensive, may be readily applied to most radiant heat problems. It also has flexibility in that it may be either fixed or movable, opaque or transparent.

Types of Screens Classified

A simple classification of the types of screens follows:

Opaque Screens — Screens which may be fixed or movable and do not require transparency:

1) Reflecting screens, made of highly reflecting material, such as aluminum, tinplate, nickel or chromium. Excellent screens are made of aluminum foil backed by gypsum board; aluminum siding provides a more permanent form.

2) Absorbing screens, made of highly heat absorbing materials such as steel and iron. These surfaces absorb radiant heat and convert much of it into convectional heat; the remainder is re-radiated at a lower temperature. Sheets of insulating material are even better.

3) Heat exchanging screens, usually made of iron or steel and water cooled. The heat absorbed by the screen is removed from the area by the water.

Transparent Screens — Screens

TABLE 1 — RELATIVE CONTRIBUTIONS of radiation and convection to total heat load imposed on the man

Test location	Heat exchanges Radiation	Convection	Btu per hr Total*	Radiation** % of total	Convection** % of total
D4	2550	1030	4530	56	23
D6	2190	570	3710	59	15
D7	1360	640	2950	46	22
D10	2390	1010	4350	55	23
D12	1390	540	2880	48	19
D15	1775	570	3295	54	17
D16	3110	590	4650	67	13
A11	3480	315	4745	73	7
A12	1940	120	3010	64	4
A14	2630	110	3690	71	3
A15	1775	120	2845	62	4

*Includes a metabolic rate of 950 Btu per hr, which is the normal rate of body heat production during average work.
**The man's metabolic heat (950 Btu per hr) accounts for the remainder.

TABLE 2 — REFLECTIVITY of various substances

Aluminum foil	95%
Stainless steel	78%
Bronze paint	65%
Aluminum paint	31-73%
Asbestos cloth or paper	8%
White enamel	8%
White paper	6%
Flat black lacquer	2%

which absorb or reflect radiation, such as wire mesh screens and special types of glass. There are innumerable wire mesh and glass products which may be readily adapted to a given situation where it is necessary to observe the operation.

Table 2 lists a few of the common materials used for screening and gives their reflectivity properties.

Table 3 illustrates the benefits to be derived from screening. This data was obtained in an experimental radiant heat screening program which was carried out on the heat exposures listed in Table 1.

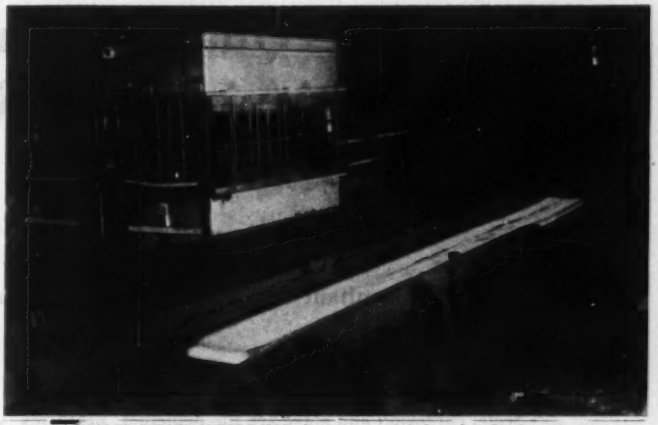
The radiation screens used in this study were of the reflective type, consisting of nothing more than aluminum foil tacked onto light wooden frames. The screens were then placed, wherever possible, between the operator and the heat source and the improvement in environment measured by means of the globe thermometer.

A reduction of 50 to 75 percent in radiant heat load was effected by these simple and rather crude screens. To achieve an equivalent improvement by ventilation would have been impractical, requiring approximately a 30 F drop in air temperature.

Where an environment is contaminated with radiant heat, there can be no excuse for neglecting to screen the heat sources. There are great potentialities in screening and an intelligent heat evaluation and control program will add to the health and morale of workers, help production and product quality, and in general make these so-called "hot" jobs more acceptable.

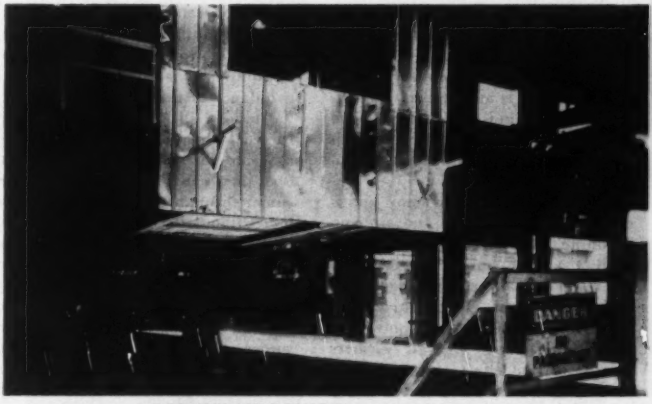
TABLE 3 — REDUCTION IN RADIATION by screening (single sheet of aluminum foil)

	Heat exchange by radiation Btu per hr		
Test location	Without screening	With screening	% reduction in radiation
D4	2530	840	67
D6	2190	740	66
D7	1360	470	65
D10	2390	950	60
D12	1390	535	62
D15	1775	735	59
D16	3110	780	75
A11	3480	1200	66
A12	1940	930	52
A14	2630	780	70
A15	1775	760	57



RADIANT HEAT SHIELDING by means of infrared reflecting glass on the hot side of a rolling mill pulpit

CORRUGATED ALUMINUM provides radiant heat protection on this bloomer mill pulpit



A ROLLING MILL PULPIT protected by aluminum

Photos courtesy of Bethlehem Steel Co.

Water Quality Control for Air Conditioning and Refrigeration

By Ralph M. Westcott
Consultant on Water Use and Quality Control

Scale, corrosion and algae are the principal problems which may develop from water use in heat exchange equipment. Increased temperatures increase chemical reaction rates and cause some actual chemical changes in the composition of the water. The physical characteristics of any heat exchange system have a decided influence on the problems from water use. A complete water analysis and competent interpretation of the analysis and the physical design of the system are the first steps toward water quality control. The variety of possible problems and solutions will justify a thorough study of the problem before taking any steps toward a treating program. Every water use in heat exchange equipment justifies a water quality study to minimize future problems

WHENEVER THE CAPACITY of a refrigerating or air conditioning system is large enough to preclude the use of air for condensing, water becomes an essential commodity for its successful operation. If water were merely H_2O, as it is too generally believed to be, a simple set of rules could be formulated for its use which would be applicable under all similar conditions. Unfortunately, water —as we obtain it for use—is generally a very complex chemical liquid. Because water is an excellent solvent, we find all kinds of minerals and gases dissolved in it which complicate its use in heat exchange equipment.

Of course, water has many applications in refrigeration and air conditioning in addition to condenser cooling. Heat pump systems may use water by taking advantage of its high specific heat. Evaporative coolers use the latent heat content of water for cooling, and air washers use the solvent effect of water to remove impurities from the air. It is used as a heat carrier, as in a chilled water circulating system.

The initial quality and quantity of water available must be given prime consideration at the design stage of any heat exchange system where water will be a component of its operation. It would be meaningless and presumptive to prescribe any set of rules to follow which would assure trouble-free operation from the use of water. However, the mere recognition that water quality may present a problem in the operation of equipment is the first step toward avoidance of future trouble.

Almost all water utilities are forced to handle carefully the water they are distributing in such a way that they can deliver it to the consumer through their distribution system without its causing undue trouble for the utility. This may mean an elaborate treating plant to assure trouble-free operation in the distribution system as well as to provide an acceptable water to the consumer. It is a virtual impossibility for a utility to provide a water that will be acceptable for use in all applications.

It is this knowledge by the water user that the water was safely delivered to him that causes him to be indifferent to his own potential water use problem. Often, the utility supplies a water which is very delicately balanced in chemical composition but when it is put to use it may be aerated, heated, cooled or evaporated and any one of these processes will materially upset that initial delicate chemical equilibrium.

There are many methods used for quality correction and control, but no one method is applicable in all instances. The major methods used for water quality correction include chemical additions to the water at point of usage, pretreatment before use by removal or replacement of troublesome constituents, and cathodic protection applied to the system for corrosion control.

Forms of Impurities Found in Water

Some understanding of the forms of the impurities found in water is necessary. Most of these are called ions, which means they are atoms or groups of atoms which have lost

or gained electrons and are therefore positively or negatively charged particles. Those particles which have lost electrons are called cations and are positively charged, whereas those which have gained electrons are negatively charged and are called anions. Most of the constituents with which we are concerned in water chemistry are ions and result from neutral salts being in solution. Further, water analyses are based on the determination of these ions and not on the combined neutral salt forms. Thus, calcium and sulphate are determined as individual constituents and it would be very rare that the quantities of each would be present in the exact amount that would require each fully to form calcium sulphate.

Table 1 is a list of the chemical substances more commonly found in water.

When a complete water analysis is made, the reacting quantities of the cations must exactly equal the reacting quantities of the anions. Small differences within the limits of experimental error will always appear. Thus, an analysis which is exactly balanced has probably been calculated rather than determined experimentally. The individual quantities of the various constituents may vary over a wide range of concentrations and will be limited only by their solubilities in combination with the other constituents present.

The Three Main Problems

The three main problems encountered with water usage are scale formation in the system, which cuts down water circulation and heat transfer; corrosion, which means loss of prime metal of the system; and organic growths, which may easily plug the entire system. Generally speaking, the troubles that accrue from water come on gradually and may not be recognized as existing until a series of leaks begin to occur or heat transfer falls off to the point where it is noticeable in the conditioned space or in the operation of the equipment.

Scale and corrosion very rarely occur simultaneously. This is easily understood when it is recognized that there is generally an equilibrium point in the concentrations of the various impurities found in water where corrosion will occur on one side of the balance point and scale

TABLE 1 — CHEMICAL SUBSTANCES commonly found in water

Cations
Sodium, Na^+
Potassium, K^+
* Calcium, Ca^{++}
* Magnesium, Mg^{++}
Iron, Fe^{+++}
Aluminum, Al^{+++}
Manganese, Mn^{++}
Anions
* Bicarbonate, $(HCO_3)^-$
* Carbonate, CO_3^{--}
* Hydroxyl, OH^-
* Chloride, Cl^-
* Sulphate, SO_4^{--}
Fluoride, F^-
Nitrate, NO_3^-
Other Constituents or Values:
* Silica
Boron
* Carbon Dioxide
* Dissolved Oxygen
* Hydrogen Ion Concentration, pH
* Total Solids, sum of constituents
* Hardness, calculated as $CaCO_3$
* Alkalinity, calculated as $CaCO_3$

*These values are essential for evaluating water for heat exchange applications.

on the other side. Some years ago, Professor Langelier, at the University of California, developed equations based on certain constituent concentrations which would predict the probable action of the water; this is now known as the Langelier Index of Saturation.

This index is a valuable tool for the water chemist, since it gives him a fairly accurate approximation of what to expect with any given water. The index is calculated by knowing the concentrations of calcium, alkalinity, total solids, the pH and temperatures involved. A value known as the pH of saturation, pH_s, is determined and if this pH_s is less than the actual pH, the water will be scale forming and if the pH_s is higher than the actual pH, the water will be corrosive—that is, $pH - pH_s = Index$. This is all very reasonable since scale generally occurs at higher pH values and corrosion at lower pH values.

Calculation of the saturation index will not provide the cure for the problem and there are generally a number of alternative methods available to provide correction. Selection of the best method generally involves such things as economics and personnel responsibility for control of the treating process. For example, if the water is scale forming, it may be softened before use by two or three methods—zeolite, cold or hot lime process; or acid could be added, keeping the calcium in solution by reducing the pH and alkalinity, or a chemical added to the water such as poly-phosphate which permits a super-saturation of calcium bicarbonate before scale forms. The method selected for use will depend on quantities of water involved, cost of equipment, space requirements for equipment, and operating and chemical costs balanced against end use advantages.

A note of warning is in order at this point, and that is to maintain a general air of skepticism when listening to eloquent but often unfounded claims. This is a harsh warning, since there are many competent men selling chemicals for water treatment. Generally speaking, beware of the chemicals sold by compound number or name where the specific chemical formula is withheld or not available to the buying public. There is no such thing, to my knowledge, as a secret formula and where one is claimed it is time to question the matter.

Corrosion Control More Difficult

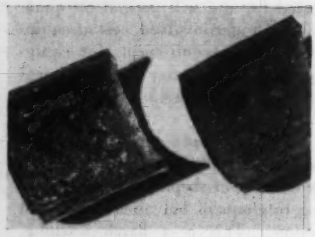
Corrosion control is often more difficult to achieve than scale control. The bill for corrosion in the United States has been variously estimated at between $5 to $10 billion annually. The National Association of Corrosion Engineers, with a membership in the thousands, attests to the complexity and severity of the problem.

Oxygen is the principal cause of all corrosion from water. This does not mean that all water which contains dissolved oxygen is excessively corrosive but it does mean that if all dissolved oxygen could be removed from water before and during use, corrosion would be substantially eliminated in water systems.

Carbon dioxide dissolved in water also contributes a great deal to its corrosiveness. The Langelier index is again proved valid because if the saturation index is positive, the effect of oxygen will be minimized due to the scale forming tendency of the water and the formation of a protective coating on the metal. If the saturation index is negative, there is no natural protective film formed on the metal and the corrosive oxygen and carbon dioxide will readily attack the metal.

A Few Specific Examples

Examples of a few specific cases may help to emphasize the need for competent analysis of water and interpretations of analytical results. A water analysis, no matter how com-



CONDENSER TUBES HAD TO BE REPLACED about every three years because of perforations due to corrosion. The method of correcting the trouble is summarized in the text as Case No. 1

plete and accurate, is worthless without proper interpretation.

Case No. 1—Cooling tower with horizontal closed shell and tube condensers

The city water supply for this system would normally be considered of good quality; it is low in hardness (calcium and magnesium content), low in alkalinity, low in total solids and has a pH of 9.2. The saturation index is plus 0.4, which means that it should be scale forming. The history of this job is that condenser tubes have had to be replaced about every three years because of perforations due to corrosion. Certain constituents dissolved in water act as buffers to keep the pH from shifting rapidly; that is, they act as a high specific heat material does in requiring more heat for a change in temperature than does a low specific heat substance. This particular water is low in buffer salts and as it was circulated through the cooling tower, CO_2 and, in this case, air polluted with sulphur compounds were readily dissolved in the water, and the pH oftentimes dropped to below 7.0. At these times, the saturation index would become negative to the extent of 1.5 or more.

Analysis of a number of samples taken over a period of days showed a marked increase in sulphates, which—coupled with the low pH and oxygen saturated water—was causing the corrosion. The oxygen could not be controlled because of the aeration through the cooling tower but the sulphate concentration could be controlled by bleed from the system and the pH could be controlled by the addition of soda ash. In addition to these controls, a polyphosphate was added to provide a broader base for control by providing some surface protection to the metal when the pH was below saturation and scale control when the pH might be too high. To complicate the problem still more, the water velocity in the tubes of the condensers was far below turbulence or at least below adequate velocity for good heat transfer and chemical treating protection. The program of treatment as outlined above provided considerable improvement this past season but has not yet given perfect control.

Case No. 2—Water cycle heat pump

There are three wells supplying water for this system. Two of the wells are drawing water from around 200 ft and the third at about 900 ft. The quality of the deep well water is entirely different from that of the two shallower wells including a slight temperature differential used to advantage in the heat pump system. Analyses were made of these three well waters at the time the wells were completed. Although interpretation of these analyses showed that the water from two of the wells might be corrosive, no action was taken to prevent this possibility, due to other seemingly more important problems encountered at the time.

In a very short time after the system was placed in operation (about two years) leaks began to develop in the copper tubing of the radiant panels. At this point, everybody concerned on this job wanted to know why and most of all what could be done to stop this corrosion. Inspection of the system showed that in addition to copper corrosion, there was also excessive corrosion in the ferrous portions of the system—condenser tube sheets, piping, etc.

A review of the original water analyses and further current analyses indicated quite clearly what was happening. The deep well was used primarily as a disposal well in the summer because of temperature advantages, and the shallow wells as supply. The shallow wells provide a very soft water with a low pH, some dissolved oxygen, and a high dissolved CO_2 content—indicating an unstable corrosive water. All of the details and problems encountered cannot be covered here but it appears that almost immediate relief from leaks was obtained by using the water from the deep well in the panels. The deep well water is quite hard, has no dissolved gases and the pH is slightly above saturation.

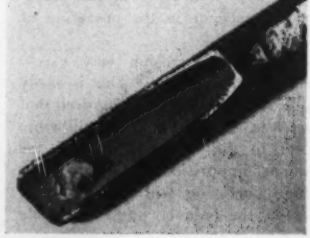
This problem has not been finally solved by this simple expedient of changing to a more desirable water. Because everyone connected with this installation is now aware of the problem of water usage, continual checking is being carried on and it is now indicated that there is a slow but steady deterioration of the deep well water taking place. If this continues, it will probably require some rather elaborate chemical treating equipment and additional costs for chemicals and operation.

Case No. 3—Evaporative condenser

This need not be any specific case since it is a very common problem. The evaporative condenser is a pretty compact and efficient heat dissipating machine. The major portion of the heat dissipated is accomplished by the latent heat of vaporization of water and this means the loss of pure water by evaporation. To maintain a constant supply of water for circulation, fresh water has to be added to make up for that lost by evaporation.

The incoming make-up water has all of the impurities characteristic of that particular supply but the water which evaporates takes substantially none of these impurities out of the water circulating system. As a result of this process of evaporation and make-up, the impurities continue to concentrate in the circulating water unless removed. The satisfactory method of removal of these salts is to bleed or drain off a portion of the concentrated circulating water and

TUBING IN RADIANT PANELS of heat pump system using water from wells began to develop leaks a very short time after system was put in operation, as explained in Case No. 2 in text. Note tubercle above perforated pit, and hole at lower right edge of tubercle



replace it with fresh water of a lower concentration. The rate of bleed will be determined by initial quality of the make-up water. A good rule of thumb is to bleed off an amount equal to half of the normal make-up rate.

A specific example of trouble developing from overdoing a treating job is one where a softener of the zeolite type was installed on the make-up water line to an evaporative condenser. The particular water in this case was high in sulphate and chlorides and when completely softened by the removal of the calcium and magnesium became very corrosive. The softener eliminated the scale but it almost eliminated the evaporative condenser too.

Another example of evaporative condenser trouble is one involving slime growths which do not require sunlight, as do the green algae. A classic case was an evaporative condenser in a chili powder factory. The odor from the volatile oils released from the chili as it was ground was quite noticeable. In a matter of weeks after this system was installed, the slime growth in the evaporative condenser was intolerable. Manual cleaning was hopeless since the stuff couldn't be washed out. Numerous chemicals were tried in an attempt to gain control over this growth, each without much success, and some drastically attacked the metal. It was finally determined that the growth was the result of the nutrient oils in the air combined with the warm humid atmosphere in the condenser and the equipment was sealed up in a room to which fresh air was supplied from an outside duct. The happy ending was that the growth was brought under control and now some years later there is no slime problem.

This same initial mistake is now being repeated many times. Evaporative condensers are being used as exhaust fans for many conditioned spaces or air exhausts from food storage spaces where the atmosphere contains nutrients for slime growth. The moral might be: Don't try to make a piece of equipment serve too many purposes—it might backfire.

SLIME ACCUMULATING in evaporative condenser in a perfume manufacturing plant. The same problem often comes up where an evaporative condenser is used for exhausting air from spaces where the air contains nutrients for slime growths. (See Case No. 3 in text)

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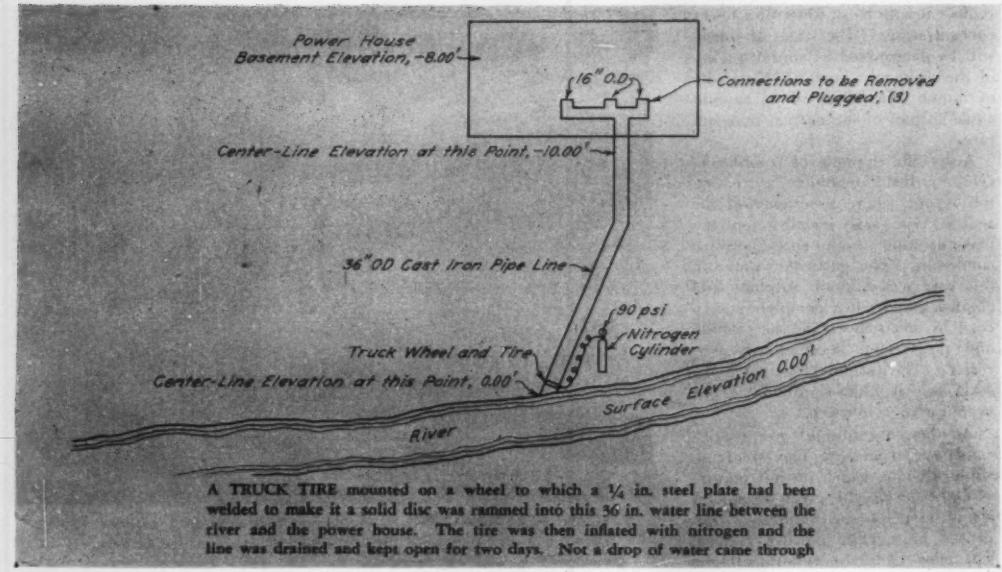
AEC RELEASES GROUP OF PATENTS

AMONG A GROUP of 15 patents owned by the U. S. Government and held by the Atomic Energy Commission which were recently transmitted to the Patent Office for registry and listing is No. 2,555,996, issued June 5, 1951, the inventor being R. B. Pontius. The needle type valve disclosed in this patent is useful for controlling the flow of corrosive gases. This valve has a control chamber of variable size with a flexible wall encompassing the flow control elements so that a minimum number of moving parts are exposed to the corrosive gases.

The AEC will grant non-exclusive, royalty-free licenses on the listed patents, as part of its program to make non-secret technological information available for use by industry. Applicants for licenses should apply to the Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington 25, D.C., identifying the subject matter by patent number and title.



A TRUCK TIRE mounted on a wheel to which a ¼ in. steel plate had been welded to make it a solid disc was rammed into this 36 in. water line between the river and the power house. The tire was then inflated with nitrogen and the line was drained and kept open for two days. Not a drop of water came through

Ingenuity Solves Piping Problem

Truck Tire Rammed Into 36 In. Line Is Inflated, Blocks Off Water While Piping Changes Are Made

By J. A. Kelleher
Kelleher Engineering Co.
Piping Contractors

IN THE PROCESS of making some revisions in the piping — which were necessary due to enlargement of the power plant — at the Ford Motor Co. Hegewisch assembly plant at Chicago, we found it necessary to block off a 36 in. cast iron pipe line between the power house and the river.

No Valve To Hold River

We had dismantled some pumps that discharged into this line, and were required to plug the openings below the floor to permit refinishing the concrete floor. There was no valve to hold back the river, the line terminated at the river wall on a miter, and the bottom of the line at the river was 18 in. below the surface. The line dropped about 10 ft in the direction of the power house.

Our solution to this piping problem was to obtain a used truck tire having a diameter of approximately 36 in., as well as a wheel and a tube to fit. We welded a ¼ in. steel plate to the wheel to make it a solid disc, mounted the tire on the wheel, and placed it — deflated — into the end of the 36 in. line. We rammed it into place with 6 x 6 timbers.

We then inflated the tire, using nitrogen, which is handled commercially in cylinders similar to those for oxygen. We used an oxygen regulator and hose to pass nitrogen into the tube.

With 90 lb per sq in. pressure in the tire, we had the line drained and open for two days, during which time we carried on our work.

Big Sigh of Relief

Not a drop of water came through, but each of us breathed a big sigh of relief when we had finished and tested out. If we had submerged that power house, I guess I would still be running.

The Law and Your Profits

Errors and Compensation

HUMAN BEINGS AND mistakes are natural team-mates — even in the engineering field, where precision is the keyword. However, the courts seem somewhat kindly disposed toward the occasional slip-ups of engineers of good-will, as a recent case reveals.

Wye & Zee (a fictitious name), consulting engineers, were retained by the owner of a business building, whom we'll call Mr. Landrich, to furnish plans and specifications for a heating system and to superintend its installation. The engineers stated that the system would be sufficient in size and design to heat the building to a temperature of 70 deg.

When the installation was completed by a responsible contractor, under the engineers' supervision, the system proved inadequate. Investigation disclosed that Wye & Zee had made a mathematical error which caused the system's failure.

To correct this mistake, the engineers drew supplementary plans calling for additional equipment and the relocation of existing equipment. Landrich accepted these plans and the contractor did the work, but at an additional cost to the owner.

In consequence, Landrich sued Wye & Zee for a sum, less the balance due the engineers on their agreed fee. He did not claim that he was damaged by inadequate heating between the first and second jobs, nor did he offer evidence that he would not have contracted for the heating system if he had known at the outset what it would cost when effectively completed. Furthermore, Landrich did not try to show that he could have obtained a heating system answering his needs at a cost less than that charged him by the contractor.

The owner's claim for damages against the consulting engineers may be analyzed thus: Relying on the plans and specifications first furnished by Wye & Zee, he was erroneously led to expect that under the original contract he would receive a complete and adequate heating system for $4602. However, to obtain

such a heating system Landrich had been compelled to spend an additional $1403, making it cost him a total of $6005. His suit was for the difference between what he *expected* the heating system would cost and what it *did* cost.

Wye & Zee put in a counterclaim for the unpaid balance of their fee. They admitted their error but argued that they had supplied supplementary plans which, together with their original plans, provided for the installation of an adequate system. The engineers figured that, due to increased costs of materials and labor between the original and final transactions, the outlay for installing such a system would have been only $183 less under plans correctly drawn at the outset, *not* the $1403 difference between expectation and actuality. Wye & Zee admitted their liability for the lesser sum and were willing to deduct it from their fee.

The engineers won their case, both at trial and on appeal, though the higher court held that they had "negligently" made the error.

This error, ruled the appeals tribunal, cost the owner the lesser amount named by Wye & Zee. In the opinion of the court, this sum placed Landrich in the same position he would have occupied if the error had not been committed. A larger sum would have enabled him to profit by his engineers' mistake.

The agreed fee — a percentage of the work's cost under the *original* plans and specifications — was not increased, either by preparation of additional plans or by increase in cost of the system. This was deemed important by the court, which held that the additional plans constituted a *full*, though *delayed*, performance of the engineering contract, and "together with the original plans, fulfilled" the engineers' contractual obligation. Such performance by Wye & Zee, coupled with making good the loss arising from their neglect, entitled them "to the balance of their fee."

Compensation is the basic principle of damages. That is to say, the party injured by breach of a contract should be placed in as good a position as he would have enjoyed if there had been full performance. He is not entitled, *because* of the breach, to be put in a *better position*. His compensation is for losses that are the *natural* consequences and *direct* results of the breach.

[Note: While this discussion applies to an actual case, it must be remembered that legal rules vary in different states.]

William Hurd Hillyer, author of this article, is a contributor to a number of banking and financial publications and has written several books on business. A former vice president of the Atlanta Trust Co., his work there gave him a practical legal background.

14,000 PAGES ON A POSTAGE STAMP

A PAGE OF PRINT from an ordinary book has been reduced to such a degree that it is possible to place no less than 14,000 complete pages of print on an area the size of a postage stamp, according to the United States Testing Co. The stunt was done to describe the possibilities of high resolution photography, a specialized field it has recently entered.

Sam Lewis Page

. . . . . pertinent comment on practical problems

• Informal comment on heating, piping and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer and a member of HPAC's board of consulting and contributing editors. He discusses this month the "circle of life and invention" as applied to heating equipment and methods, and particularly to double duct arrangements for heating such buildings as schools.

DUCT LAYOUTS FOR HEATING SCHOOLS

I AM CONTINUALLY reminded of the great circle of life and invention. It is especially noticeable in mechanics, and in the division of mechanics having to do with heating, ventilating, and air conditioning. There seem to be cycles of popularity with such equipment as spreader stokers, underfeed stokers, downdraft furnaces, Scotch marine boilers, horizontal return tubular boilers, etc., for example.

Some 50 or 60 years ago, an all-indirect warm air heating system for public buildings, such as schools, was popular. That was in the comparatively early days of automatic temperature regulation.

Temperature control in such systems sometimes was achieved by using double air supply ducts, often made of masonry, below the main floor and occupying the full width of the corridors.

There would be a warm air chamber, perhaps 3 ft high for a large building, separated by a deck from a relatively cool air chamber below it, frequently two-thirds as high as the warm air chamber — as suggested in Fig. 1. When these ducts came to the base of a vertical flue, the flue had openings to both ducts, each fitted with a damper so arranged that as the warm air damper opened, the cool air damper closed commensurately. A thermostat in each room served by each flue was expected to adjust the interlocked dampers.

The scheme worked fairly well in small buildings. If the superimposed ducts were long, however, the transfer of heat from the warm air duct to the cool air duct, through the dividing deck, reduced the temperature differential between the two kinds of air to such an extent that the rooms most remote from the supply fan were very slow to heat, and having been heated, were very slow to cool.

Sometimes this scheme was used with metal ducts along the basement ceiling. In such installations, the rate of heat transfer through the metal deck or barrier was even more rapid than it was with the masonry ducts and the masonry deck.

The double air duct arrangement occasionally is employed in short lengths, but I had considered it to be obsolescent. Recent articles, however, have brought the news of the "rediscovery" of the double duct system and its use for heating, by warm

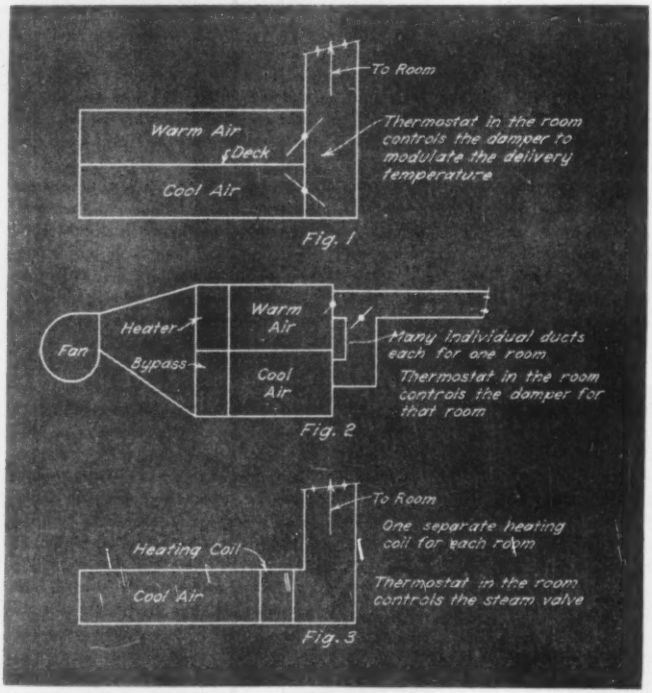


FIG. 1—DOUBLE DUCT arrangement as used for heating schools . . . FIG. 2—KEEPING THE WARM and less-warm air chambers close to the fan and heaters, as indicated here, reduces the objectionable heat transfer from the warm to the cool duct . . . FIG. 3—IN THIS SCHEME, there is a steam or hot water coil at the base of each flue or near the air supply entry to each room.

air furnaces, a long, single story, modern school building.

Keep Chambers Close To Fan and Heaters

A design that is perhaps more likely to be troublefree and that would require no more metal would be one which kept the two chambers, one of warm air and one of less-warm air, close to the supply fan and to the heaters, as per Fig. 2. The heaters could be either furnaces or steam coils.

The same double mixing damper may be used as with the double duct system, but each damper may be connected with its respective flue by a single horizontal duct. The ducts vary in length as the flues or rooms differ in distance from the supply fan and the two chambers. The ducts may be somewhat larger in cross section as the distance increases, and may be smaller if the flues are nearby.

The objectionable transfer of heat from one duct to the other, even though the separate ducts are side by side, is much less rapid than is the case with the double duct scheme where the cool air has so much chance to gain heat from the bottom of the warm air duct.

Heating Coil in Flue for Each Room

One way to dodge the trouble, not possible with warm air furnace systems but suggested in Fig. 3, is to deliver all of the air through a single duct, at a temperature of about 60 deg, and to warm it further, say to 120 deg, with a steam or hot water coil at the base of each flue or near the air supply entry to each room. The thermostat in the room may then open or close the supply valve to the heating coil.

The air introduced into the room most distant from the supply fan will be — with this plan — as warm or as cool as that introduced into the nearest room. Adaptations of this general arrangement have been used for many years in a number of public schools, notably in Chicago and in Toledo and Columbus, Ohio.

Special Heating and Cooling Systems Serve Mobile Army Mapping Units

SPECIALIZED REQUIREMENTS of the U.S. Army Corps of Engineers mapping units are met by a complete heating, cooling and ventilating system serving a standard map reproduction van-type body mounted on a standard military truck chassis.

The major components of the system are mounted over the cab in an aluminum shell constructed over welded steel structural supports and the ventilating system is located within the van. The heating system utilizes a gasoline burning aircraft heater. An axial flow blower, driven by a ¼ hp, 24 volt, d-c motor serves in the heating cycle and for the cooling cycle air supply.

Diffusion of cool or warm air is accomplished by a system of air ducts and air diffusers mounted on the ceiling and along the lower front panel of the van. The system can be regulated to provide the mixture and circulation of air desired. This method provides uniform heating of the van interior from floor to ceiling. The air cooling system, like the heating system, is thermostatically controlled.

Safety was one of the major considerations in the design of the heating system. Since the heater draws its fuel from the truck gas tank, the danger of fire caused by filling heaters while in operation is eliminated. In addition to this, the combustion chamber is equipped with a safety drain which prevents the accumulation of unburned gas. A drainage line extends from the heater down to the chassis of the truck, discharging its contents, if any, onto the ground. The danger of carbon monoxide being introduced from the heat exchange chamber or from the exhaust of the heater into the van body has been minimized. The heater is capable of unattended operation through the use of thermostatic controls.

Map reproduction by the lithographic process in arctic areas presents some major problems, foremost of which is maintaining the necessary range of temperature and humidity within which operations must be carried on. In fact, no matter where reproduction equipment is set up, if the working temperature is allowed to drop below plus 50 F, the reaction of chemicals slows up, equipment gets too cold to operate and the efficiency of operators is greatly lessened. If the temperature drops much lower, photographic and lithographic reproduction become practically impossible.

Reproduction trains for the production of military maps in the field are composed of a number of individual vans each housing equipment required for one or more of the component steps of the lithographic process such as the camera section, plate processing and map layout. To assure maximum efficiency and quality it was necessary to develop a means of maintaining constant temperature and humidity control.

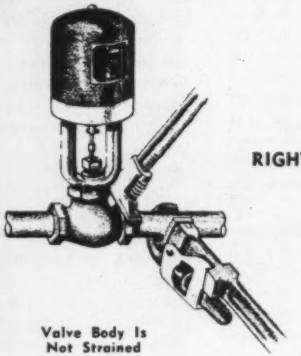
The new design adequately handles the situations under which the vans must operate. At temperatures down to −70 F, the heater can be started and will heat the van interior to plus 65 F within 1 hr from the initial cold start using 100 percent outdoor air. Recirculated air can also be used, as can a mixture.

[Photo courtesy Anemostat Corp. of America].

MAJOR COMPONENTS of heating, cooling and ventilating system are mounted over the truck cab.

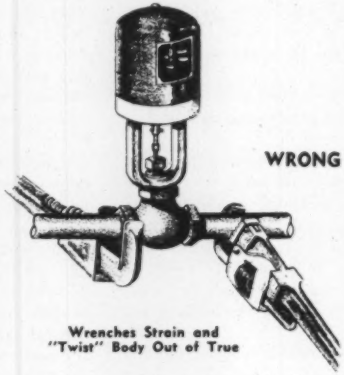
DATA sheet

"Tips" on Valve Piping



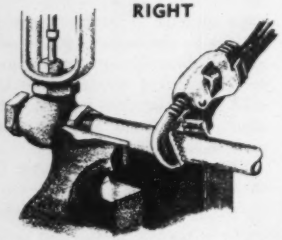
RIGHT

Valve Body Is Not Strained



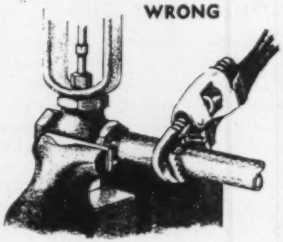
WRONG

Wrenches Strain and "Twist" Body Out of True



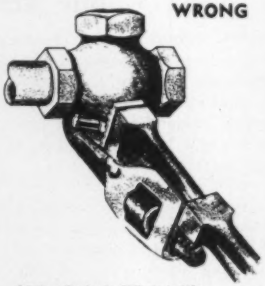
RIGHT

Valve Body Is Neither Crushed or Strained



WRONG

Valve Body Is "Crushed"

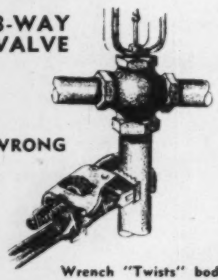


WRONG

Valve Body Is "Twisted"

3-WAY VALVE

WRONG



Wrench "Twists" body.

3-WAY VALVE

RIGHT WRONG

Pipe Threads Too "Long." Pipe "Jims" Seat.

RIGHT WRONG

Pipe Threads Too "Long." Pipe "Jims" Seat.

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QUESTION of the Month

QUESTIONS ON heating, piping and air conditioning asked by HPAC's readers are answered here each month. We hope you find these practical comments of regular interest. Why don't you contribute either a question, or an answer to a published question, for next month's issue? We'll be glad to hear from you. Just address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Illinois.

VENTILATING, COOLING A LAUNDRY

A CONTRACTOR READER of HPAC has a customer interested in ventilating or cooling his laundry in Ohio. This reader asked for comment on how such a job might be done, and inquired if evaporative cooling has ever been successfully applied to an installation of this kind. We asked W. F. Archibald, department of production and engineering, American Institute of Laundering, and Samuel R. Lewis, consulting engineer, and a member of HPAC's board of consulting and contributing editors, to discuss this question. Their remarks follow.

WE HAVE NOT published anything regarding the ventilation or cooling of laundries as each problem is entirely different due to structural differences in the buildings as well as climate differences. Air conditioning, in general, has proved too expensive to be practical in a laundry.

We know of no installation which uses evaporative cooling, as this system would increase the moisture content of the incoming air. The problem of air conditioning a laundry is not as much a matter of temperature as it is humidity. The moisture must be removed, and this alone would make for better working conditions in most cases. In some areas, cooling must also be considered; however, cooling alone does not give enough benefit to warrant the expense.

In the only system approaching evaporative cooling of which I know, the air is drawn through a tunnel before going to the laundry. The walls of this passage are lined with coke and well water is allowed to filter through the coke to cool the walls and thereby cool the incoming air. This is more of a heat exchange (rather than evaporative) type of installation, as the cooling water does not come in contact with the incoming air so as not to increase the moisture content.

Individual systems have been designed to fit particular plants which bring in cool air and, by means of duct work, openings are provided which direct the cool air onto operators or into restricted areas so as to control the passage of air through the area, then onto the machines and up to an exhaust fan.

Ventilation, in general, is usually figured by a rule of thumb which varies from 12 to 30 changes of air per hour. The minimum is necessary for the ideal day and the maximum for a day when air is heavily laden with moisture.

The tumbler area should have an air change at least every three minutes. The flatwork area should be exhausted at least once a minute. The washroom area should have an air change at least every five minutes. Press areas should be exhausted every four minutes.

With these figures, unit coolers for operator comfort sometimes are installed, but an economical method of conditioning such a large volume of air at reasonable costs has not as yet been devised.—W.F.A.

OCCASIONALLY, WE RECEIVE an inquiry as to whether evaporative cooling for some too-hot room or building is practicable. Before attempting an answer, we must be told the general location of the project and must learn the character of occupancy.

For example, evaporative cooling in the Southwest undoubtedly accomplishes worthwhile cooling in hot weather when the humidity of the atmosphere is low and as a result it is anxious to absorb moisture. For every pound of water or water vapor that the air absorbs, there is 1 deg of temperature reduction divided between the air and the remaining water. Thus, the water in the porous crockery drinking water jars that hang in the shade of southwestern ranch house porches becomes delightfully cool.

Many Arizona homes have electric fans that induce air currents through water-wetted open mesh receptacles that hold coarse fibers like excelsior or spun glass or slag.

In Ohio, on the other hand, no great success has been attained (to my knowledge) by direct evaporative cooling. This is because of the very much higher relative humidity prevalent in that area. We do employ indirect evaporative cooling very extensively, however, with unqualified success.

By indirect evaporative cooling, I mean that we operate a mechanical refrigerating compressor and change the state thereby of a refrigerant gas to a liquid. Heat released by the change of state is transferred to water at a temperature much warmer than is of any use in cooling a man for his comfort. The liquid refrigerant then is allowed to expand back to a gas and in so doing becomes cold enough to cool air down to comfort temperature.

The hot water that helped change the refrigerant from gas to liquid is sprayed into the ordinary outside air and will be cooled down to the air temperature by transfer to the air and will be cooled still further by evaporation of part of the water, so that a well sprayed cooling tower can chill the water to within about 5 deg of the outdoor air's wet bulb temperature. This slightly involved process can fairly be called indirect evaporative cooling.

Our friend wishes to reduce the temperature in an Ohio laundry by evaporative cooling. The air within laundries usually is very damp, approaching 100 percent relative humidity. We can't reduce the temperature of such air appreciably by transferring moisture out of some of it into more of it.

I have cooled large and busy

laundries acceptably by transferring moisture out of some of the hot interior air to the outside air. In other words, great improvement can be gained by delivering uncontaminated outside air into the laundry at noticeable velocities in such manner that it blows over the bodies of the people at work. The relatively cool, relatively dry, new air from outside displaces the hot moist air which is thrown away, usually through exhaust openings far overhead.

In one plant, some of the hot overhead air regularly is mixed with the new air, through thermostatically controlled dampers, so that the temperature of the air delivered to the workers is not too cool. In this plant, where we handle about 3 cfm of air per sq ft of floor, we find that the employees demand operation of the cooling system even during the coldest weather, since the surplus heat from the laundry operations warms the necessary volume of new air at no cost for fuel and does improve health and comfort and production.—S.R.L.

ONE BIG PUMP OR FOUR SMALL ONES?

IN HIS QUESTION published in the August HPAC, "E.R." asks for comment on the matter of installing four small circulating pumps or one large one for a four-zone radiant heating system in a new church.

Deciding to install one large pump or a number of small ones on a zone job is often difficult, as many times the advantages in each case are balanced.

"E.R." mentions a "radiant" heating system (which I assume means pipe or tubing in the floor or ceiling) and he also mentions that the system will consist of four zones. If this implies four separate room temperature control areas and if constant circulation of water through the panels is preferred, I believe there is no choice but four separate pumps.

If water is circulated constantly, it is of course necessary to vary the water temperature in relationship to the heating requirements. If there are to be four zones, it is safe to assume there will be times when four different water temperatures are needed.

The customary method of varying water temperature with constant operation of the pump is the installation of a valve or valve and bypass. Thus, either water is circulated through the boiler and heated, recirculated through the panels, or circulated through a combination of the two circuits. The control of the valve may be "outdoor" or perhaps by an indoor thermostat.

If the job is attempted with one pump and four valves, there is a danger of overheating as a result of the mixing of return water from any zone calling for heat with water supplying a zone needing no heat.

As an example, if Zone A is calling for heat and its valve is open, water may be supplied to that zone at 140 F. If the temperature drop through that zone is 20 deg, the return water will of course be 120 F. At the same time, it is possible that Zone B requires no additional heating and its valve is closed. However, water from Zone A returning to the common return header will be distributed, in part at least, to Zone B through its bypass. Thus, although Zone B may require water no higher than perhaps 90 deg, it could easily be supplied with water up to 120 deg and, as a result, will overheat.

The foregoing is rather obvious, and of course there are other factors, such as total horsepower requirements, service and maintenance of equipment that should be considered. However, more should be known of the job in question before these factors can be weighed.—G.W.B.

HOW WE FILE TECHNICAL DATA

HOW TO FILE technical information from articles appearing in HPAC and other magazines, data from manufacturers of equipment, and ideas and suggestions from other sources was the subject of "G.W.'s" question in the June issue.

Our filing system is based on the ASHVE's Heating, Ventilating, Air Conditioning Guide. Product information is filed according to the "index to modern equipment" given in that handbook. A file folder is made up for each heading to receive clippings, etc., referring to such products and their application. Manufacturers' catalogs are placed behind the appropriate file folders.

Technical information is filed on the basis of the chapter headings in the Guide. These file folders are alphabetically arranged in with the product files.

Thus, our copy of the Guide serves not only as a source of technical information, but also locates additional or supplementary data in our files. Since the Guide lists manufacturers of various products, we can check to help make sure our files are complete.

The index to the technical data section is invaluable in locating that article we filed away two years ago on "anesthetics", ("Chapter 7 — Air Conditioning in the prevention and treatment of disease"). Where would you file something like this and expect to find it quickly without some reference index?—W.N.D.

HOW DO YOU HEAT A TURKISH BATH?

You are invited to answer the following question from a reader of HPAC. Please address your reply to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

"Have you any record of published information on the subject of heating Russian or Turkish baths?

"I would appreciate any references on this type of installation, or comments on the proper methods of design and application."—A.T.F.

NEW BOOK PUBLISHED ON GERMAN HEATING DESIGN

REFERRING TO THE question from "M.A.Y." in the April HPAC about the Rietschel-Brabbee method of designing heating systems and sizing piping, this is also used here in Holland and I have a copy of the book on my desk. The difference between the European (non-English) and American measuring systems makes a comparison between the method and that used in the United States rather difficult.

I know, however, that a new revised edition was issued in 1950 by the Springer Verlag, Berlin, Gottingen, Heidelberg. The title is now: H. Rietschels Lehrbuch der Heiz- und Luftungstechnik, by Heinrich Grober, F. Bradtke.

If I can be of further help in this matter, let me know.—J.C.H.R.S.

Heating, Piping & Air Conditioning

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

JOURNAL SECTION

Heat Pump Application to a Newspaper Plant

By J. Donald Kroeker*, John H. Bonebrake**, and James A. Melvin†,

Portland, Ore.

SUMMARY — In this paper the authors describe the application of a water-to-water heat pump for complete air conditioning of a newspaper plant and office building. Among innovations described are use of well water for pre-heating and pre-cooling, the recovery of heat from exhaust air, and a completely automatic control system, even to the point of starting and stopping the centrifugal refrigeration equipment.

THE new Oregonian Building (Fig. 1) in Portland, Ore., completed in June 1948, was built specifically as a production plant for a modern newspaper with a daily circulation of 219,000 and a Sunday circulation of 276,000. It contains offices for editorial and business personnel associated with the production plant, and houses a radio station and studios connected with the publishing operation. The building extends five stories above, and two below ground level, and occupies completely a 200 x 200-ft city block. It is a solid block building designed specifically for newspaper production and consequently does not contain ventilating courts. It has a floor area of 220,000 sq ft and a volume of 4,270,000 cu ft. It is of steel and reinforced concrete construction and is faced with sandstone, granite, and fixed, double-pane windows, the exterior panes of which are of heat-absorbing glass.

Building Use Diverse

The east half of the building is devoted largely to the industrial processes of producing the news-

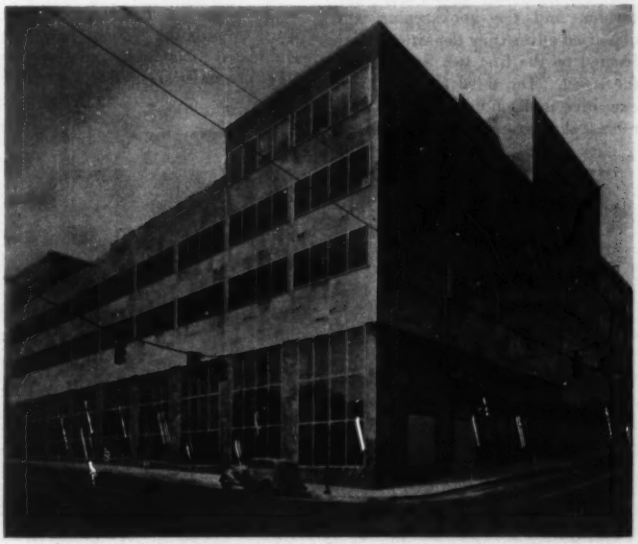

Fig. 1 — The Oregonian Building from the pressroom side

*Consulting Engineer. Member of ASHVE.
**Office of J. Donald Kroeker. Member of ASHVE.
†Chief Operating Engineer, Oregonian Building.
Presented at the Semi-Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Portland, Ore., July 1951.

Fig. 2 — Loading docks in drive-through passage

paper. It contains the presses, and extensive paper storage area on the lowest floor; a loading dock on an open drive-through court (Fig. 2) on the first intermediate level; a mailing room the full width of the building, directly above the pressroom; stereotype, linotype and etching departments above the mailing room; and employees' service areas above these mechanical departments. In all except the last mentioned space, no finish is provided on the concrete structure.

In the west half of the building there are shops, mechanical rooms, and an auditorium in the two floors below the street level. The business office, home maker's quarters, auditorium, and the bookkeeping and classified advertising departments are located on the first two floors above the street. The third floor contains executive and editorial offices, news rooms, photographic laboratories, and a library. The fourth and fifth floors are occupied by the broadcasting studios (Fig. 3) offices, and broadcasting equipment and mechanical equipment rooms. Except for those below the street floor, these spaces are finished in a conventional manner including acoustical board on metal lath and plaster ceilings.

Air Conditioning Necessary

The design of the heating and air conditioning system was based on temperatures of 10 F for heating and 95 F dry bulb with 70 F wet bulb for cooling, the basis used in Portland, and discussed in a previous paper[1]. The average winter temperature of 49 F is significant in studying heat pump system design for maximum practical economy.

Table 1 — Building Requirements in Mbh

Nature	At 10 F	At 49 F
Building loss or gain	3500	1250
Ventilation Air	5700	1250
Total	9200	2500

While the Portland climate is relatively mild and air conditioning of office buildings is not general practice, it was necessary to use complete air conditioning in this building because ventilating courts had been eliminated to facilitate uninterrupted flow of material in the mechanical processes of publication. In addition, as the structure is designed for heavy loads, deep steel beams had to be used and these prevented adoption of an all-air heating and air conditioning system.

[1]Exponent numerals refer to References.

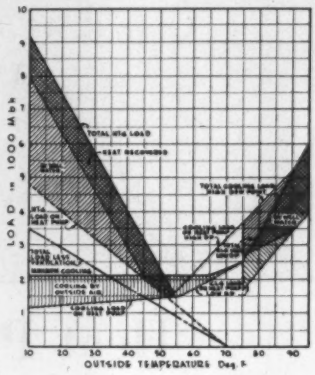

Fig. 4 — Heating and cooling load curve

Heating by air could be properly applied in the press, linotype, stereotype, and mailing rooms. In the west half, largely housing office areas, it was necessary to use a split system, consisting of ceiling panels for base heating and an air distributing system designed for air conditioning and control of space temperatures. A brief description of some of these systems may contribute toward a better understanding of the heat pump application.

System Requirements Varied

Ten air conditioning units supply air at a rate of 204,000 cfm, 99,000 cfm of which is recirculated. Because of the diversity of conditions and the use of various spaces, 90 zones are provided for temperature control. All outside air and recirculated air is passed through electrostatic air filters.

Each of 10 air conditioning units is separately controlled by a program clock, since a newspaper plant operates around the clock and the different departments have varying periods of occupancy and use. Eight of the units are of double-plenum type with bottom location of cooling coil and cooling plenum

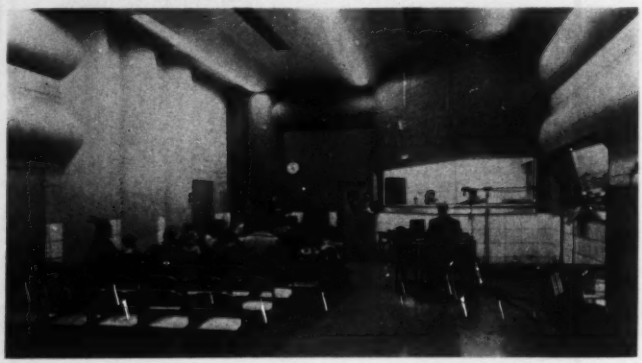

Fig. 3 — Modern broadcasting studios on fourth floor

and top location of heating coil. Individual zones are connected by separate ducts to each plenum. The temperature in individual zones is regulated by mixing dampers controlled by room thermostats. Thermostats in all rooms connected to one air conditioning unit are interlocked so that the room requiring the greatest amount of heating will control the warm plenum temperature, and the one needing the most cooling will control the cool plenum temperature.

In general, humidity control was provided as a high limit only in that no attempt was made to humidify, except in the pressroom. Thus, one humidistat for each unit maintains a maximum of 55 percent relative humidity in the space served by that unit. In the main pressroom where it was desirable to maintain 75 F dry bulb and 55 percent relative humidity, with little variation, full humidity control was necessary.

It will be observed that the several heating and air conditioning systems are conventional in most respects. An exception is the use of coils to recover heat from exhaust air, practicable only with a low temperature medium, such as is available in the use of the heat pump.

After the requirements and necessary heating and conditioning equipment were established as described, the heating and cooling loads were analyzed as shown in Table 1 (Fig. 4).

The cooling demand of 6,000 Mbh was taken as 30 percent under the aggregate computed heat gain, because a considerable diversity in operation of units, although indeterminate, was expected, and because cooling loads are less than computed heat gains.[3]

Heat Pump Feasibility Established

While early indications were that an application of a heat pump to the building systems[1] appeared economically practicable, giving promise of providing the lowest available operating costs, the decision to use the heat pump was delayed until a complete analysis could be made. A summary of this analysis is shown in Table 2 and is based on well water availability and temperatures reasonably assured by previous experience with wells in the general area. The analysis indicated that the contemplated application could result in a heat pump load of 4,000 Mbh for cooling and 4,800 Mbh for heating, providing that well water was used for the bulk of the pre-heating and pre-cooling of ventilation air, as well as for series flow through the evaporator and condenser during periods requiring cooling only.

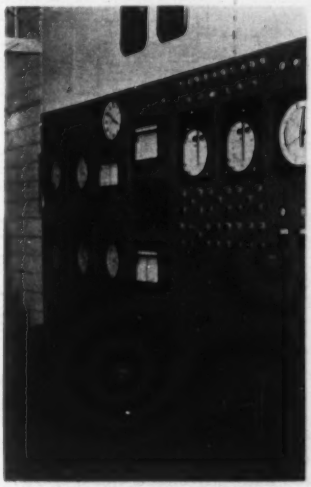

Fig. 6 — The system nerve center is panel board opposite heat pump

Elements of the heat pump system include drilled wells to provide the well water which serves as the heat source; deep well pumps; a sand-settling, or surge tank for well water; three so-called settling tank pumps

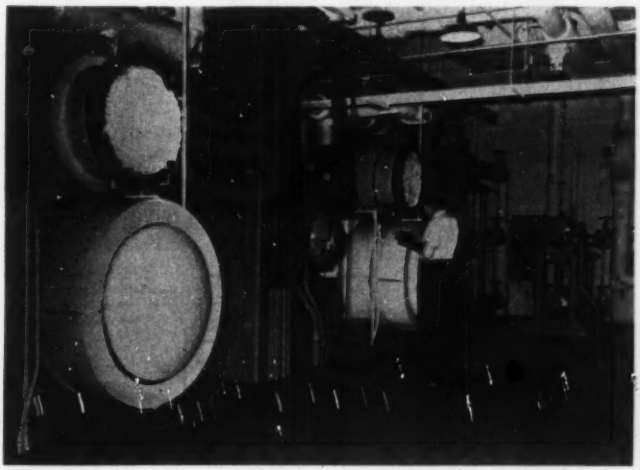

Fig. 5 — Mechanical room with heat pumps at left, circulating pumps beyond

Table 2 — Heat Balance at Two Conditions in Mbh

Item	Heating at 10 F		Heating at 49 F	
	Heat Obtained	Energy Required	Heat Obtained	Energy Required
Heat Pump	4800	1640	1800	360
Well Water Pre-Conditioning	3200	111	—	—
Recovery from Exhaust Air	1200	53	700	70
Totals	9200	1804	2500	430
Less Cooling By-Product		255		310
Net Energy Required		1549		120

Table 3 — Well Characteristics

Well	Total Depth (Ft)	Pumping Data		Temp (F deg)
		Flow (Gpm)	Head (Ft)	
DP-1	235	600	145	54
DP-2	204	600	142	55
DP-3	930	500	263	58

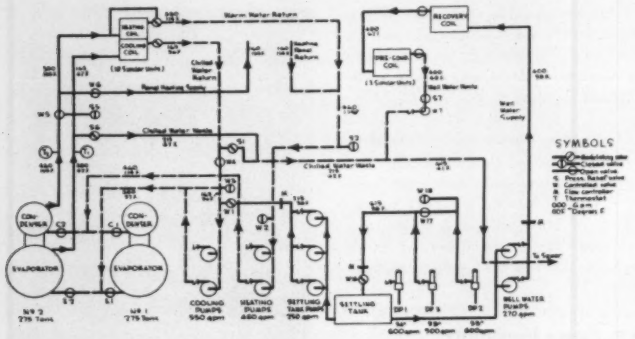

Fig. 7 — Cycle 1, flow diagram, heating load the greater

to introduce well water into the piping system; two heating pumps; two well-water circulating pumps; two cooling pumps; two refrigerant compressors with heat exchangers (Fig. 5); and various automatic sequence and temperature control devices (Fig. 6).

Heat Source Developed

Experience with wells in downtown Portland indicated that water, at about 55 F, should be available in a relatively impervious formation at a depth of 200 ft for use in condensers during cooling. It also indicated that warmer water should be available in a pervious formation at about 500 ft. It was considered that two 200-ft wells at 55 F, and one 500-ft well at 57 F, should be available, the latter for use as a heat sink during cooling. Since it was not possible to determine drift between the 200-ft wells, disposal to sewer was contemplated during use of the deeper well. Actual well conditions developed are shown in Table 3. Wells DP-1 and DP-2 were used to supply water during cooling (with disposal to DP-3). Well DP-3 was used for heating, the water being finally discharged to sewer although this incurred a city sewerage charge.

All pumps used were standard centrifugal units with constant-speed electric motors. They were installed in vertical groups for simplified piping and space saving, with each group having one stand-by pump. The settling tank pumps, mounted over the settling or well-water receiving tank, were equipped with automatic primers.

Well water circulating pumps (a relatively minor investment) were provided to precondition ventilating air during both heating and cooling and thereby reduce the load and required capacity of the heat pumps (as shown in Table 2).

Operation Under Unusual Conditions

The refrigerant compressors (using Freon 11) are of the centrifugal true-volute type, with wound rotor motors on 12-step controllers, and suction dampers for operation below surge points. The ancillary heat exchangers are standard shell-and-tube, multi-pass units, designed especially for the application. Nominal capacity of each assembly is 275 tons. They operate under two unusual conditions:

1. These heat pumps are probably the first of this type that are provided with safe sequences to permit fully automatic operation.
2. Since panel heating was a requisite, and the ceilings in which the coils were located are finished with acoustical board, a high panel water temperature, or a high condenser water leaving temperature, was required. Consequently, it was necessary to select refrigerant compressors and their heat exchangers for a leaving water temperature of 135 F, higher by 30 deg than such machines in prior normal applications.

Flow Diagrams Traced

Control equipment provides, in addition to automatic start, for automatic sequence selection by an outside thermostat and water temperature levels. It also provides for automatic reset of leaving condenser water temperatures by an outside thermostat.

Operation of the heat pump and the systems served are shown in three flow diagrams. For convenience, they are designated as three cycles specifically:

1. *Cycle 1*, Heating load the greater, Fig. 7.
2. *Cycle 2*, Heating, with cooling the greater, Fig. 8.
3. *Cycle 3*, Cooling above 75 F, Fig. 9.

Actually, as such, there are no cycles. Changeover from one se-

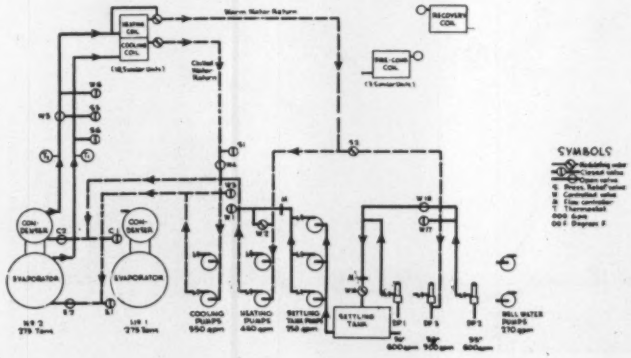

Fig. 8 — Cycle 2, flow diagram, heating, with cooling the greater

quence of water flow to another is made automatically as certain control points are reached. This is determined by sequence and heat pump controls mentioned. These diagrams show the significant valves and controls only. Piping and equipment not in use during a cycle are shown unconnected or deleted to simplify study.

Cycle 1: Well water is pumped from DP-3 at 58 F into the settling tank and from there a pump supplies it to the suction line of a cooling pump. This pump then supplies it to the evaporators, where a portion of it is discharged directly to the sewer through a pressure relief valve, S6. The remainder is conveyed to cooling coils of the air conditioning systems and is discharged to the sewer through pressure relief valve S1. During this cycle, the heating circuit is closed. In the cycle, water is conveyed by a heating pump to the condensers, where it picks up heat and flows to the heating coils and the heating panels, and finally back to the pump.

A well water pump takes water from the settling tank during the cycle, conveying it through the heat recovery coils in exhaust air streams, where it is heated to 62 or 63 F, then to the pre-conditioning coils and finally through pressure relief valve S7 to the sewer. At 10 F outside temperature, the discharge to sewer is at 40 F.

Flow data and progressive water temperatures in each circuit are shown in Fig. 7 for this cycle. When cooling exceeds heating, which occurs when the outside temperature rises to 52 F, valves are automatically repositioned and pumps automatically operated to provide Cycle 2.

Cycle 2: Circuits in Fig. 8 apply during heating above 52 F outside temperature, when the cooling requirement exceeds the heating demands. Well water from DP-1 and DP-2 is supplied to the settling tanks. Pumps introduce 54 or 55 F water to the suction of a heating pump, which conveys the well water to a condenser and open heating circuit. At this time, the panel heating system is off so that the water leaving the condenser flows to the heating coils and from these the excess water is discharged to the casing of DP-3 through a relief valve S2.

The cooling circuit is closed during this cycle. Water is circulated by a cooling pump through the evaporator and the cooling coils in a closed system. The well-water recovery and pre-conditioning system is not in operation, because the outside air temperature is too close to the water temperature to permit advantageous operation. When the outside temperature rises to 75 F, and no further heating or heating-up can be required, valves are automatically repositioned and the pumps change to the operation shown to provide Cycle 3.

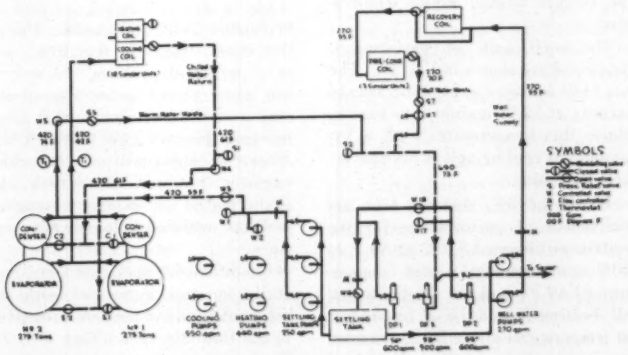

Fig. 9 — Cycle 3, flow diagram, cooling above 75 F

Circuit Reduces Load

Cycle 3: The heat pump operated for cooling alone is shown in Fig. 9. DP-1 and DP-2 pump the respective wells to the settling tank in this cycle, while the cooling pumps and the heating pumps are idle. The settling tank pumps send well water directly to the evaporators at 55 F, and from these the cooling coils of the several units are supplied. They discharge through the condensers to pick up rejected heat, and then through relief valve S5 to the casing of DP-3 at 73 F at design conditions.

A well water pump also provides 55 F water to precondition ventilation air, by-passing the recovery coils, which provide no advantage, and discharging through relief valve S7 to the casing of DP-3 at about 62 F.

This cycle reduces the load on the heat pumps from the design value of 6,000 Mbh to 4,000 Mbh. Only a part of the reduction is due to the well water pre-conditioning circuit. The major reduction is accomplished by use of return of water from the coils to the condenser, instead of to the evaporators, thus providing a 6 deg lower temperature of water entering the evaporators.

In all cycles, the start is automatic, and is at the command of the time clock on any of the 10 air conditioning units, with the result that the central equipment operates when any one of the conditioning units starts. Water temperatures are maintained automatically according to outside temperatures and are controlled by means of industrial controllers having thermostatic elements in the discharges of condensers and evaporators, shown as T_2 and T_1, respectively, the latter maintaining a constant value of 42 F.

T_1 controls the capacity of the unit or units in operation by increasing or decreasing the speed of the wound rotor motors, which drive the compressors, and also by operation of the suction dampers to the compressors. T_2 in the condenser discharge, reset by an outside thermostat, controls the amount of well water introduced and determines the circuit into which well water is introduced.

Coefficients of Performance Analyzed

With the heat pump system arranged as indicated, coefficients of performance, COP, were computed during design, to determine thermodynamic characteristics and economical efficiencies of the heat pump system and its component parts compared with systems employing conventional heat sources, such as boilers or district steam mains. Values in Table 2, extended, provided the basis for such analysis.

The *job coefficient* was computed as the ratio of the total heat used in heating the building and in heating the air going into it as related to the total electrical energy used by the system in producing that heat. All units of heat and electricity are expressed in Mbh (thousands of Btu per hour).

The three main sources of heat listed are the heat pump, well water for preconditioning, and exhaust air heat recovery. Power to auxiliaries included with power to the heat pump under *energy required* is power for a cooling pump, settling tank pumps, a heating pump, and half of the power for the deep well pump. The other half of the power for the deep well pump, and two-thirds of that for well water pumps, are included under energy required for the well water pre-conditioning system.

The other third of the energy required by the well water pre-conditioning system was charged to the recovery system, since approximately that portion of the energy was required to circulate the water through the recovery coils. In addition, half the energy required for the exhaust fans was charged to the recovery system, as the coils increased static pressures on the fans by about that amount.

Except as described for the recovery system, energy for the fans is not included under required energy, since they would have required about the same power input, regardless of the heat source. Power to heating and cooling pumps might also be properly exempted, but is included in the interest of conservatism, and to avoid additional complexities involved in considering partial loading. Consequently, the *gross* coefficient of performance was taken as the total heating load divided by the total energy required, as described, and this term is comparable to the usual designation of *heat pump with auxiliaries*.

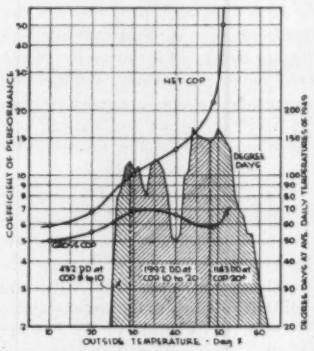
NET COP
DEGREE DAYS
COEFFICIENT OF PERFORMANCE
DEGREE DAYS AT AVG. DAILY TEMPERATURES IN RANGE
OUTSIDE TEMPERATURE - Deg F
492.00 at COP 8 to 10
1992.00 at COP 10 to 20
1683.00 at COP 20+

Fig. 10 — Graph of coefficients of performance and degree days at average daily temperatures of 1949

The *net* coefficient of performance was taken as the gross COP with credit for the heating effect, the by-product of the cooling required even at heating design temperatures. The deduction used to arrive at net energy required, Table 2, was the amount of energy required by the compressor for the cooling demand. The *net* COP was the ratio of the heating load to the net energy required for the heating at the several outside temperatures studied, including 49 F, the average normal winter temperature.

The coefficients of performance developed are shown in Fig. 10. The net COP becomes asymptotic toward infinity at 52 F, inasmuch as heating above this temperature is all a by-product of cooling and is not chargeable to heating.

It will be seen that the high net coefficient of performance for the system as designed (10.2 at 30 F to 20.8 at the average winter temperature of 49 F) and the condition that all heating would be a by-product at temperatures above 50 F, provided an obvious basis for the selection of the heat pump for this application.

Superimposed on the COP curves of Fig. 10 is a plot of degree days, computed from frequency of occurrence of average daily temperatures, indicating that the bulk of the heating in 1949 was available at relatively high coefficients of performance. This emphasizes further the significance of the study of average winter temperature data in determining annual costs for energy. Temperatures for a specific year were used here in preference to normal daily temperatures to illustrate a typical year.

Innovations Listed

A brief summary of the non-conventional elements of a large heat pump which were applied to this installation includes the following (*a*) No auxiliary means of heating is provided; (*b*) well water has been used directly to recover heat from exhaust air and to precondition ventilation air, both improving the *job COP*; (*c*) a completely automatic installation has been provided to reduce the amount of operating personnel and to provide greatest economy; and (*d*) centrifugal refrigerant compressors and heat exchangers have been adapted to provide heating water temperatures as high as 135 F.

Operating Experience

The Oregonian heat pump was placed in operation in June 1948, and was operated manually as the building was occupied before automatic controls were complete. Automatic operation was inaugurated in September 1948, and continued until December 1948. At that time, due to a personnel problem, the system was again placed under manual operation, and functioned in that manner from January 1949 to May 1949. After the employment of a new chief engineer, however, the system was again placed on automatic control, and has operated automatically ever since.

Conditions of operation were generally in close agreement with the values of flow and temperatures given in the flow diagrams (Figs. 7 to 9). There were some notable exceptions, however. The building was not com-

pletely occupied, a large television studio being still unoccupied, and this reduced substantially the actual load on the equipment.

Capacities have been planned to provide for operation of a single heat pump machine down to 25 F outside temperature, the other serving as standby. A single machine has been able to satisfy the heating demands down to 10 F outside.

During design, it was thought desirable to use 54 F water for cooling and 58 F water for heating, with 55 F water added as necessary for either heating or cooling. In practice, it developed that the 55 F water is not required during the heating season, with the result that deep well DP-3 alone carries the heating load.

Experience with other wells below the 200-ft level had indicated presence of a considerable subterranean drift, with the result that, when higher temperature water was delivered to the well, the well temperature on subsequent pumping remained constant at the original value. This was not the case with DP-3, the 930-foot well. At the beginning of the heating season, after warm condenser water has been delivered to this well throughout the summer, water drawn from this well is at 77 F, and, in operation of some six months for heating, it drops only as low as 61 F. This reduces materially the amount of water required from the well.

Another variation found in operation is that the system changes from Cycle 1 to Cycle 2 at temperatures from 2 to 4 deg lower than anticipated. This results in a higher average coefficient of performance than expected, inasmuch as the average winter temperature approximates 49 F.

It has also been found that operation of the heating panels is not required above 52 F, the air systems adequately maintaining temperatures at points above this value. In addition, the starting point of Cycle 3 has become 71 F instead of 75 F as planned.

Despite the fact that development of wells resulted in sandfree water, excessive quantities of sand were settled out in the settling tank and this required considerable maintenance. The sand condition was due to the starting and stopping of the deep well pumps, which shocks the wells. It was overcome by installing a valve in the supply to the settling tank, to modulate the flow and keep the deep well pumps in operation until the required flow from them was approximately 10 percent of the normal capacity. This, too, is accomplished automatically. The modulation of the well water supply to the settling tank has resulted in the collection of less than one cubic yard of sand in nine months of operation.

Another effect of the sand in the system was the scoring of pump shafts which were refinished by stainless steel spraying.

The use of well water in the system has resulted in some corrosion. Steel pipe was used, except in the panel piping, which was copper tube, and in the coils which also were copper and contained brass turbolators.

The water in DP-1 and DP-2 contained about 60 ppm of carbon dioxide and was slightly acidic, with iron content substantially below values giving normal concern. The water of DP-3 contained no carbon dioxide and was slightly alkaline, but did, however, contain substantial amounts of chlorides.

Since the system contains a number of circuits in which the flows are variable according to load conditions, it was not practicable to determine requirements for treatment, if any, at the outset. In view of the presence of an acidic water with a high carbon dioxide content, some corrosion was expected and treatment was contemplated, based on the types and amounts of corrosion which might be found in the system soon after it was put into operation. Due to problems with operating personnel, other activities took precedence over early analysis of corrosion conditions. By May 1949, corrosion which might have been arrested earlier, became serious and strong dosages of chemicals became necessary. According to corrosion consultants employed, ferrous corrosion carried to the brass and copper in the system, setting the stage for corrosion in these portions also. The system is now being treated regularly with modest amounts of suitable chemicals.

The Oregonian heat pump system was not provided with instruments for obtaining detailed records of operating results, such as obtained in the Equitable Building and reported previously[2]. Consequently, it has not been possible to determine the actual coefficients of performance under the conditions of operation found in this installation. Nevertheless, it may be conservatively stated, on the basis of experience with the Equitable Building, and on the basis of the shifting of control points between cycles in the Oregonian heat pump system, that coefficients of performance are substantially higher than those shown in Fig. 10.

Conclusions from Experience

Numerous conclusions which apply to commercial heat pump installations were drawn from design and operating experience. The following might be useful to others in planning large heat pump installations:

1. The economy in recovering heat from waste products, and the preconditioning of ventilation air with cold water, should be investigated.
2. A commercial heat pump installation can be only as good as the automatic temperature and sequence control provided. Consideration of only industrial types of controls which can obtain greater accuracy and flexibility than usual air conditioning and heating controls is recommended for use in basic master control sequences.
3. Abnormally detailed studies of loads and methods will pay dividends in economy of operation.
4. Determination of economic feasibility requires a rather thorough study of application methods. Comparison of only power rates, arbitrarily chosen coefficients of performance, and costs of alternate energy available, will be misleading and inconclusive.
5. Well water development should precede design, since, in many localities, information based on performance of wells in the vicinity may not apply fully.
6. Sand traps in well water supplies, such as settling tanks, are justified, even for wells apparently entirely free of sand.
7. Water analyses should be carefully studied for possible chemical treatment required to protect system metals. The employment of consultants is advised. Some advice of purveyors of proprietary compounds has been found to be misleading and flavored with prejudice.
8. Shafts of pumps handling well water which show even traces of sand should be

made of hardened metals, such as stainless steel, or of the molybdenum group of alloy steels.

9. Generally, a heat pump installation having a capacity of more than 150 tons will require, even though it is fully automatic, at least the part-time attention of an operating engineer, who may also have other duties. Such a person should be personally selected or subject to approval by the designing engineer.

References

1. A Heat Pump in an Office Building, by J. Donald Kroeker and Ray C. Chewning (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, March 1948, pp. 121-28).

2. Heat Pump Results in Equitable Building, by J. Donald Kroeker, Ray C. Chewning, and Charles E. Graham (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, July 1949, pp. 115-21).

3. Heat Gains Are Not Cooling Loads, by C. O. Mackey and N. R. Gay (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, August 1949, pp. 105-113).

Discussion

LESTER T. AVERY, Cleveland, Ohio: In our section of the country return wells are required for all supply wells. In this paper I notice that wells are at two different levels with two different temperatures, the one at the 900 ft depth being 58 deg, and the one at the shallower depth being 54 deg. I would like to ask whether consideration was given, or could be given, to returning the cold water at one level and the hot water at the other to see if some regain might be obtained. When returning warm water to the ground, we find a gradually increasing supply temperature, which indicates short circuiting. They are suspicious that we are running out of cold well water in Ohio.

AUTHORS' CLOSURE: I'm glad that question came up. As suggested in the paper, wells should be developed before decision is made to use a heat pump system of a water-to-water type.

In a heat pump application which we described in two previous papers, we were able to take the water from one level and dispose of it to another. If we were cooling, we took water from a cooling well, where there was a good drift, and disposed of it into the warmer wells where, unfortunately, there was not much drift, but where there was sufficient capacity to receive most of the water. In these installations we had to dispose of some overflow to the sewer for our heavier cooling loads.

Placing warm water into a well having no drift provides a tremendous thermal advantage as the heating starts.

In the case of the Oregonian Building, we encountered well trouble. The first two wells developed were relatively shallow (200 ft deep) and the flow was free. We then indicated that the third well should be drilled to a greater depth, to provide a separation that would permit wasting from one level to another. This well was drilled through solid rock for 500 ft and water was finally reached at 903 ft. In comparable situations in this area, other wells were drilled only to the 500 ft level to reach the lower water.

We expected to obtain 750 gpm with a drawn down to about 300 ft. We were able to obtain only 500 gpm. We then decided that it was necessary to make connections to the sewer because we could not discard that water into the upper level (from which we had to pump for heating) in case we would have the cross circuiting that Mr. Avery mentioned.

An interesting condition eventually developed in that well. It is now pumping 750 gpm although all we could get originally was 500. In place of a pumping level of 300 ft, we now have a pumping level of about 200. Another interesting point is that the expected drift in this well did not materialize. The result is that when the so-called heating season starts in November, the water supplied by the well is in the neighborhood of 83 to 85 F, much less water is used, and less pumping is necessary.

The warmer temperature in this well at the start of the season reduces to some extent the value of the preconditioning circuit for heat recovery and the amount of preconditioning with well water at outside temperatures of 40 to 45 F because recovery cannot be obtained when the water temperature is higher than, or very close to, the temperature of the air from which heat recovery is attempted.

Each well must be treated as an individual case. Analysis of the wells' eventual use will have to be made after they are drilled.

The procedure of including wells in the general contract and specifying performance is undesirable. Unfortunately, the architects with whom you work will insist upon specifications.

NAME ASHVE DELEGATES TO LONDON CONGRESS

T. H. Urdahl, Washington, D.C., and L. P. Saunders, Lockport, N.Y., have been named official ASHVE delegates to the 1951 Building Research Congress in London, September 11 through 20. Mr. Urdahl, who went to England to attend the Festival of Britain, also will visit Sweden, Norway, and Denmark. He left by air August 12 and is to return on the French Liner La Liberte, September 18. Papers by five Society members are scheduled for presentation at the Congress. The authors are: F. W. Hutchinson, Berkeley, Calif.; C. O. Mackey, Ithaca, N. Y.; Dirk Van Zuilen, The Netherlands; Poul Becher, Denmark; and J. F. L. Grocott, England.

NEWEST LIGHTING ADVANCES PRESENTED

The latest advances in lighting research and application were presented at the National Technical Conference of the *Illuminating Engineering Society*, August 27 through 30, in Washington, D.C.

John R. Allen Memorial Library

The ASHVE Committee on Research gratefully acknowledges the following gifts to the John R. Allen Memorial Library, which is maintained at the Society's Research Laboratory, 7218 Euclid Ave., Cleveland 3, Ohio.

Handbook of Oil Burning, Frank H. Faust and G. Theodore Kaufman, editors, published by *Oil-Heat Institute of America, Inc.* Gift of G. Theodore Kaufman.

District Heating Handbook, third edition, Pittsburgh, Pa., *National District Heating Association*, 1951. Gift of *National District Heating Association*.

The presentation of textbooks and pamphlets in the field of heating, ventilating, and air conditioning and allied fields, by authors and others, will be welcomed by this library. Suitable book plates carry the name of the donor and date of the gift.

Pressure Losses of Take-Offs for Extended-Plenum Duct Systems

By J. W. Holl*, S. F. Gilman**, R. J. Martin† and S. Konzo††, Urbana, Ill.

SUMMARY—An investigation has been conducted to determine the pressure loss characteristics of standard side and top take-offs used with an extended-plenum duct system. Studies were made with two sizes of plenums and several sizes of branch ducts and take-offs.

The results showed that the pressure losses of all take-offs did not depend upon the size and shape of the extended plenum or the size of the take-offs. Furthermore, the performance of a take-off was not affected by the relative locations of other take-offs.

The pressure losses of all take-offs were found to be a function only of the ratio of the velocity in the branch duct to that in the plenum.

A practical interpretation of the results has been included.

THE EXTENDED-PLENUM type of air conditioning duct system is characterized by a main duct of the same size and shape throughout its length, designated as the *extended plenum*. The take-offs connecting the extended plenum with the branch ducts are one-piece fittings of simple construction.

Because of the overall simplicity of extended-plenum systems, both the fabrication and installation costs are often less than those of conventional trunk duct systems. Although these advantages have been recognized for some time, complete information for design purposes is not available in the literature.

An investigation of the pressure losses of various types of 7-in. diameter take-offs installed one at a time on a 12-in. × 8-in. extended plenum has been reported by other investigators.[1] As a result, certain sizes and shapes for side and top take-offs were accepted by the industry as standard. Since the reported results were restricted to one size of branch duct and one size of plenum, further research with other sizes of branch ducts and plenums is desirable.

Objective of Investigation

The objective of the investigation reported in this paper was to determine the performance characteristics of extended-plenum and branch-duct combinations, such as are normally used in residential air conditioning applications, utilizing standard take-offs. The items which were investigated in the laboratory and which are discussed in this paper are the following:

1. The performance of standard side and top take-offs when used alone on two different plenums.
2. The effect of the relative locations of two or more take-offs on the pressure loss of individual take-offs.
3. The application of the laboratory results to the design of extended-plenum systems.

Description of Apparatus

The principal details of the laboratory apparatus are shown in Fig. 1. The four orifices in the orifice box were used singly or in parallel to measure the total air flow rate in cubic feet per minute, depending upon the volume range desired. The speed of the centrifugal fan was varied over a wide range by the use of two adjustable rheostats in conjunction with a direct current motor. The fan discharged the air from the orifice box into the auxiliary plenum and thence into the extended plenum. The function of the auxiliary plenum, nozzle, and egg-crate straighteners was to provide a uniform velocity profile at Station O. The air was then discharged from the extended plenum through the branch ducts and plenum exit section. The dampers were adjustable and were used to establish and control the desired conditions. A 3-ft section of the extended plenum adjacent to the first take-off connection was fitted with a transparent top and bottom to permit visual observation of the air flow pattern in the extended plenum and take-off. Qualitative flow patterns were determined by probing this section with a silk thread attached to a small diameter rod.

Studies were conducted with two 24-in. wide extended plenums, one of which was 8-in. deep and the other 12-in. deep. During these studies, one or more branch ducts were connected at different locations on the extended plenum. The top and side take-offs used in this investigation were the types accepted as standard by the *National Warm Air Heating and Air Conditioning Association*. The construction details of these take-offs are shown in Fig. 2; they have been designated by the letters A through G for ease of reference. These 7-in., 8-in., and 9-in. diameter take-offs connected corresponding sizes of branch ducts to the plenums.

Referring to Fig. 1, Station O was the primary energy measuring station, and any station along the plenum downstream from Station O was designated by its distance, in feet, from Station O. Thus, Station 6 and Station 9 were located 6 ft and 9 ft, respectively, downstream from Station O. The static pressure at Station O was measured by means of a piezometer ring, and the total air flow at Station O was determined by means of the orifice box. The static pressure tap located at the center of

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†Associate Professor of Mechanical Engineering, University of Illinois. Member of *ASRE*.
††Professor of Mechanical Engineering, University of Illinois. Member of ASHVE.
[1]Exponent numerals refer to References.
Presented at the Semi-Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Portland, Ore., July, 1951.

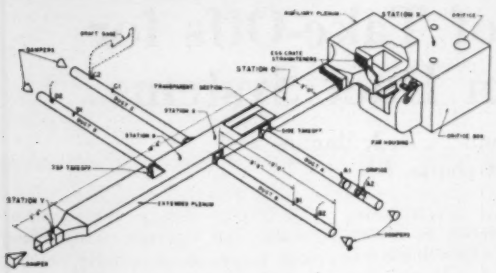

Fig. 1. General arrangement of apparatus

Take Off Designation	Branch Duct Diameter D
A	7
B	7
C	7
D	7
E	8
F	9
G	8

Take Off Classification	Dimension L
7S	12
7S	12
7S	12
7T	12
8S	14
9S	16
8T	14

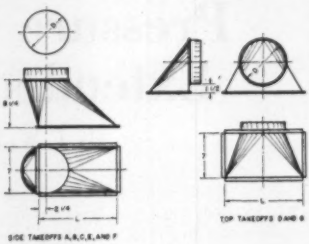

Fig. 2. Details of take-offs

the top of the orifice box, Station X, was used to measure the pressure differential across the one or more orifices in use. The static pressure at any station in the plenum downstream from Station O, such as Stations 6 and 9, was measured by a Pitot tube. The volume (cfm) leaving the exit section of the extended plenum was measured at Station Y.

The energy measuring stations in the branch ducts were designated by the numeral 1 following their identifying letters, and the flow rate measuring stations were designated by the numeral 2 following their identifying letters. For example, Stations A1 and A2 in Fig. 1 refer to the respective energy and flow rate measuring stations in Branch Duct A.

Calibration of Apparatus

A micromanometer[2] was used to calibrate the 16 inclined draft gages to obtain calibration curves for correcting the gage readings to their true values.

The flat-plate orifices in the orifice box were initially calibrated in place by means of a circular duct and Pitot-tube traverses. After calibration, any air flow rate between 80 and 2400 cfm could be determined from static pressure readings at Station X.

At the end of the extended plenum, a total-pressure tube and a static-pressure tap were used to measure the velocity pressure at the center of the 8-in. × 8-in. duct at Station Y downstream from the converging nozzle. During calibration of this station, all branch ducts were closed, and the relation between the velocity pressure at Station Y and the volume (cfm) entering the orifice box was obtained. Any air flow rate between 180 and 1800 cfm leaving the plenum could then be determined from the velocity pressure at Station Y.

A total-pressure tube and static-pressure tap similar to that employed at Station Y were used to measure the velocity pressure in each branch duct. During calibration of any branch duct, the other branch ducts and the exit section of the plenum were closed and the relation between the velocity pressure just downstream from the branch duct orifice and the volume entering the orifice box was obtained. Any air flow rate between 80 and about 600 cfm could then be determined from the velocity pressure reading in the branch duct.

General Procedure and Compilation of Data

For a given configuration of the apparatus, the dampers were set at desired positions. The total volume (cfm) entering the apparatus was then varied over a wide range in about four steps, by varying the fan speed, and the various pressure readings were recorded. The dampers were then reset to other positions and the same procedure was repeated. By this method, the volume flowing in the branch duct and in the extended plenum were varied over a wide range. The mean velocity at any cross-section of the apparatus was calculated from the air flow rate and the cross-sectional area.

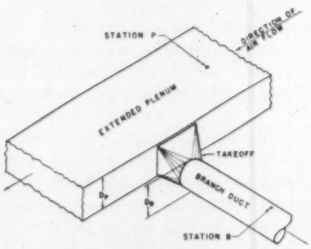

Fig. 3. View of an extended plenum, side take-off, and branch duct

In order to evaluate the pressure loss of a take-off, it was necessary to obtain pressure readings which were not influenced by the disturbances caused by the air flowing from the plenum and through the take-off to the branch duct. By probing the cross-section with a Pitot tube upstream from the take-off in the plenum and downstream from the take-off in the branch duct, desirable locations for measuring stations were obtained. The plenum energy measuring stations were located from 1½ ft to 3 ft upstream from the take-off, depending upon the number and spacing of the take-offs in use. The branch duct energy measuring stations were all 6½ ft downstream from the take-off.

For the purpose of illustrating the method used to calculate the pressure loss of a take-off, Fig. 3 will be utilized. The total pressure in the plenum was expressed as:

$$(TP)_P = (SP)_P + (VP)_P \quad \ldots(1)$$

where

$(TP)_P$ = total pressure in the extended plenum upstream from the take-off at Station P, inches of water.

$(SP)_P$ = static pressure as measured at Station P, inches of water.

$(VP)_P$ = velocity pressure corresponding to the mean velocity of flow at Station P, inches of water.

The total pressure in the branch, $(TP)_B$, was evaluated in a similar manner.

The pressure loss between Stations P and B is

$$H = (TP)_P - (TP)_B \quad \ldots\ldots\ldots(2)$$

where

H = pressure loss between Stations P and B, inches of water.

The take-off loss was separated from the normal duct friction loss in accordance with the usual procedure of determining fitting losses on a *no-length* basis. The take-off loss was therefore defined as

$$L_T = H - L_P - L_B \quad \ldots\ldots\ldots(3)$$

where

L_T = take-off loss, inches of water.

L_P = normal friction-pressure loss in the plenum between Station P and the centerline of the branch duct, as determined from the ASHVE friction chart,[2] inches of water.

L_B = normal friction-pressure loss between the take-off and Station B, as determined from the friction chart,[2] inches of water.

Substituting Equation 2 into Equation 3, there results

$$L_T = (TP)_P - (TP)_B - (L_P + L_B) \quad \ldots\ldots\ldots(4)$$

This equation was used to compute the take-off loss.

In order to obtain a dimensionless expression for the take-off loss, each value of L_T, in inches of water, obtained from Equation 4 was divided by the velocity pressure (also in inches of water) corresponding to the mean velocity of flow in the branch duct. For the studies conducted with a single take-off installed on a plenum, the resultant expression was designated the *independent loss coefficient*, λ. Thus,

$$\lambda = L_T/(VP)_B \quad \ldots\ldots\ldots(5)$$

where

$(VP)_B$ = velocity pressure corresponding to the mean velocity of flow in the branch duct, inches of water.

When experiments were conducted with two or more take-offs installed on a plenum, the pressure loss of each take-off could conceivably be affected by the presence of the others. In order to differentiate between the two experimental conditions, the dimensionless expression obtained by the same procedure used to obtain Equation 5 was designated the *interference loss coefficient*, Θ. Thus,

$$\Theta = L_T/(VP)_B \quad \ldots\ldots\ldots(6)$$

in which it is understood that in Equation 6, L_T is evaluated from the data obtained with two or more take-offs installed on a plenum.

The difference in the loss coefficients as determined by Equations 5 and 6 was designated the *take-off interference* and served as an index of the interference caused by the proximity of two or more take-offs.

Preliminary Analysis

In an effort to determine the principal variables involved in this investigation of extended-plenum systems, an analytical approach to the problem was made. From a review of the literature and from principles of fluid dynamics, it was expected that the independent loss coefficient, λ, would be influenced by the velocity in the plenum just upstream from the take-off, the velocity in the branch duct just downstream from the take-off, the size and shape of the plenum and take-off, and the density and absolute viscosity of the air. Since air at room temperature and at relatively low velocities was to be used, the effects of compressibility and heat transfer could be safely ignored. The general relationship between the variables considered to be of significance can be expressed as

$$\lambda = f(V_B, V_P, D_B, D_P, \rho, \mu) \quad \ldots(7)$$

where

V_B = mean velocity in the branch duct just downstream from the take-off, feet per second.

V_P = mean velocity in the plenum just upstream from the take-off, feet per second.

D_B = characteristic length of the take-off and branch duct, feet. See Fig. 3.

D_P = characteristic length of the extended plenum, feet.

ρ = density of the air, pounds per cubic foot.

μ = absolute viscosity of the air, pounds per foot second.

f = symbol indicating a functional relationship.

The *characteristic lengths* D_B and D_P may warrant explanation. The selection of the particular dimension to represent a characteristic length is arbitrary for any one combination of plenum, take-off, and branch duct such as shown in Fig. 3. This is true because in describing the size and shape of an object, it is sufficient to select any one dimension; all other dimensions can then be expressed in terms of the selected dimension. For example, if the dimensions of a plenum were known, the width could be expressed as some multiple of the depth, D_P.

Applying the methods of dimensional analysis to Equation 7, there results

$$\lambda = \phi\ (V_B/V_P,\ D_B/D_P,\ V_B D_B \rho/\mu) \quad \ldots\ldots\ldots(8)$$

The last term in the right hand member of this equation is the expression for the Reynolds number referred to the branch duct. Therefore, Equation 8 can be expressed as

$$\lambda = \phi\ (V_B/V_P,\ D_B/D_P,\ R_B) \quad \ldots(9)$$

Equation 9 states that the independent loss coefficient, λ, is some function of the velocity ratio, V_B/V_P, the length ratio, D_B/D_P, and the Reynolds number in the branch duct, R_B. The equation does not provide information as to the form of the functional relationship that exists between λ and the three ratios; it states only that a general functional relationship exists between the dimensionless groups. However, considerable information can be obtained from an inspection of Equation 9. One important fact is that the dimensionless groups are independent; *i.e.*, any two can be held constant while the third is varied in any desired manner. For example, if a particular plenum, take-off, and branch duct combination is studied, the value of the length ratio, D_B/D_P, will be constant. If the total flow rate is varied, but the flow rate in the branch duct is held constant by controlling the flow with a damper, R_B will be constant and the velocity ratio, V_B/V_P, will vary. Thus, the effect of each ratio on λ can be determined experimentally by holding the other two constant. Since the research program is to be limited to a relatively narrow range of air velocities and plenum and take-off sizes, it is probable that the effect of at least one ratio will be insignificant and can be ignored. Any ratio is insignificant

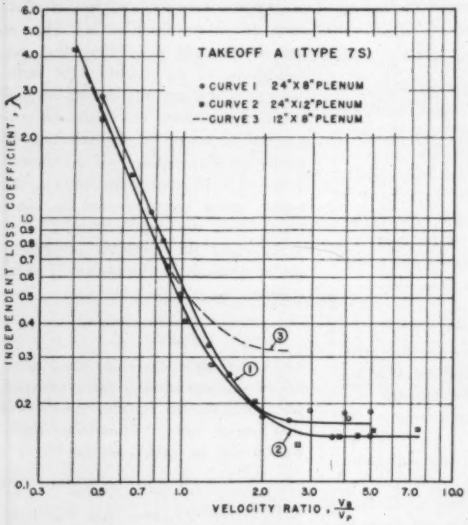

Fig. 4. Performance of a side take-off on three sizes of plenums

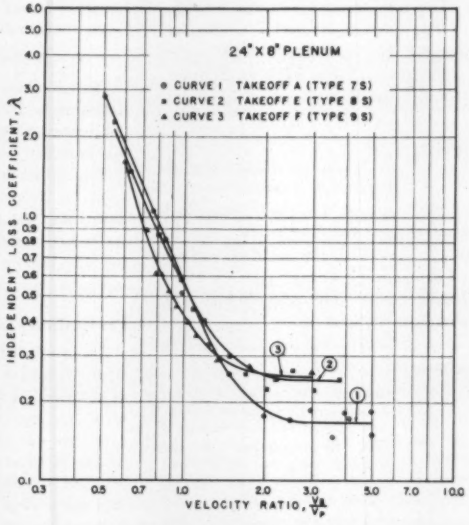
24"X8" PLENUM
CURVE 1 TAKEOFF A (TYPE 7S)
CURVE 2 TAKEOFF E (TYPE 8S)
CURVE 3 TAKEOFF F (TYPE 9S)
INDEPENDENT LOSS COEFFICIENT, λ
VELOCITY RATIO, Vb/Vp

Fig. 5. Performance of three sizes of side take-offs

if it is essentially constant over the range in which the experimentation is conducted.

Certain conclusions can be drawn from a consideration of the length ratio, D_B/D_P, in Equation 9. If the characteristic lengths D_B and D_P of one configuration of the laboratory apparatus were, for example, twice the respective characteristic lengths of another configuration, the ratio D_B/D_P would be the same for both configurations. For this condition, Equation 9 indicates that λ would depend only on the velocity ratio and Reynolds number, the length ratio being constant. Changing the values of D_B and D_P, but keeping their ratio constant, is equivalent to changing all dimensions in the same proportion; *i.e.*, changing the *size* but maintaining the same *shape*. This is exactly the condition of geometric similarity; therefore, if all of the plenum, take-off, and branch duct combinations to be studied were geometrically similar, λ would depend only on the velocity ratio and Reynolds number. Referring to Fig. 2, it can be shown that the condition of geometric similarity will not be fulfilled during this investigation. Note that although the diameters of the take-offs vary from 7 in. to 9 in., certain dimensions are the same for all take-offs. Their shapes are therefore different, and the take-offs are not geometrically similar. Moreover, in describing the apparatus it is stated that the plenums used in this investigation were of the same width but of different depths. Therefore, the plenums are also not geometrically similar. It can therefore be concluded that, because of the variable length ratios that are to be used in the investigation, the effect of length ratio on λ should be determined experimentally.

This analysis shows that the six variables influencing λ, as given in Equation 7, can be reduced to the set of three dimensionless variables given in Equation 9. The scope of the experimentation can therefore be limited to a study of each one of the three variables in Equation 9 while holding the other two constant. By this method, the extent of the actual significance of each variable can be determined.

Results of Studies with a Single Take-off

The initial studies were conducted with single take-offs installed on the 24-in. × 8-in. plenum. When compiling the laboratory data, it was found that the independent loss coefficient, λ, varied considerably with the velocity ratio. Consequently, this ratio was usually used as the basis for expressing the experimental results.

Side Take-offs: The relationship between independent loss coefficient and velocity ratio for Take-off A is shown in Fig. 4 for three plenum sizes. Curves 1 and 2 were obtained from studies conducted with the 24-in. × 8-in. and 24-in. × 12-in. plenums. Curve 3 was replotted from a previous paper[1] which reported the performance of Take-off A when installed on a 12-in. × 8-in. plenum.

A comparison of curves 1 and 3 shows the effect of *plenum width* on the independent loss coefficient. Although it appears from the curves that the plenum width has a marked effect on the independent loss coefficient at high velocity ratios, the maximum difference between curves 1 and 3, which occurs at a velocity ratio of 2.5, corresponds to a difference in pressure loss of less than four equivalent feet of 7-in. diameter duct. For purposes of system design, this

difference is negligible; consequently, it can be concluded that increasing the width of the plenum from 12 in. to 24 in. has no significant effect on the independent loss coefficient of Take-off A.

Comparison of curves 1 and 2 shows the effect of *plenum depth* on the independent loss coefficient. The maximum difference between these curves, which occurs at velocity ratios less than one, corresponds to a pressure loss of less than five equivalent feet of 7-in. diameter duct. For the purpose of design, this difference is negligible; therefore, it can be concluded that the increase in depth from 8 in. to 12 in. had no effect upon the independent loss coefficient of Take-off A. Take-offs B and C, which were similar in size and shape to Take-off A except for slight variations in manufacture, were also studied. The results showed that the individual take-off losses expressed in terms of equivalent length were nearly the same as those for Take-off A. Moreover, studies on the effect of plenum depth conducted with Take-offs B and C confirmed the conclusion stated for Take-off A.

Similar studies on the effect of plenum depth were made for Take-offs E and F. The results showed that an increase in depth from 8 in. to 12 in. had no effect on the independent loss coefficients of Take-offs E and F.

The relation between the independent loss coefficient and the velocity ratio for three sizes of side take-offs with the 24-in. × 8-in. plenum is shown in Fig. 5. These curves, which are for take-offs of different sizes and of slightly different shapes, are in good agreement with each other. Although the maximum difference between any two curves corresponds to 10 equivalent feet of round duct, this is small in comparison to the equivalent length of the entire duct system.

In the preliminary analysis it was stated that the effect of either velocity ratio, length ratio, or Reynolds number could be determined by holding any two of these variables constant and varying the third. In order to investigate the influence of Reynolds number on λ, an analysis was first made of the laboratory data obtained with Take-off A installed on the 24-in. × 8-in. plenum, since one configuration of the apparatus corresponds to a constant value of length ratio D_B/D_P. For selected values of velocity ratio V_B/V_P, values of the independent loss coefficient were plotted against the Reynolds number in the branch duct. Representative results are shown by the circled points and curves in Fig. 6. Since the curves are horizontal lines for a given velocity ratio, the independent loss coefficient is a constant. The significant conclusion can therefore be drawn that, within the limits of experimental accuracy, λ is independent of Reynolds number for the range over which data were obtained with this configuration of the apparatus.

An analysis was next made of the data obtained for all other configurations of the apparatus. For each configuration and a constant value of velocity ratio, values of the independent loss coefficient fell above and below the corresponding curves in Fig. 6. Since no trend could be established, all of the points have been plotted in black filled circles in the figure. The agreement of these points with the previously established curves permits two important conclusions to be made. *First*, for each configuration of the apparatus, λ is independent of Reynolds number. *Second*, for a given value of velocity ratio, a single curve applies within the limits of experimental accuracy to all configurations of the apparatus. Since the various side take-offs and plenums were not geometrically similar, the latter conclusion is equivalent to a statement that the effect of the deviations from geometrical similarity are insignificant. The length ratio and Reynolds number can therefore be discarded from Equation 9. The result is then

$$\lambda = \psi_S(V_B/V_P) \quad \ldots\ldots\ldots\ldots (10)$$

in which the symbol ψ_s indicates a general functional relationship applicable to side take-offs. Equation 10 expresses a unique relationship between λ and V_B/V_P that holds with satisfactory accuracy for the configurations studied and for the practical range of air flow rates. Therefore, a single curve relating λ to V_B/V_P can be used to express all of the experimental results obtained with side take-offs.

It is of particular significance that the curves of Fig. 6 are in good agreement with those obtained by other investigators for a similar 7-in. diameter side take-off and a 12-in. × 8-in. extended plenum[1].

Top Take-offs: The results of studies conducted with a single 7-in. diameter top take-off installed on the 24-in. × 8-in. plenum are shown in Fig. 7, together with the results for an 8-in. diameter top take-off under the same experimental conditions. The 8-in. diameter take-off, Take-off G, has the higher independent loss coefficient over most of the velocity ratio range. However, for practical considerations, the agreement between the two curves is good since the maximum difference between them represents less than 10 equivalent feet of round duct. Comparison of Figs. 5 and 7 shows that top take-offs have much higher pressure losses than side takeoffs for the same experimental conditions. This is to be expected because the air flowing through the top take-off must make two 90° turns in passing from the plenum into the branch duct, whereas the air flowing through the side takeoff must make but a single 90° turn.

Take-offs D and G were also studied independently on the 24-in. × 12-in. plenum. As the results were in excellent agreement with the curves of Fig. 7, it was concluded that an increase in plenum depth from 8 in. to 12 in. had no significant effect on the independent loss coefficients of 7-in. and 8-in. diameter top take-offs.

An analysis of the effect of Reynolds number and length ratio was also made with the data obtained for the top take-offs. As with the side take-offs, it was found that the laboratory results could be expressed in a unique relation of the form

$$\lambda = \psi_T(V_B/V_P) \quad \ldots\ldots\ldots\ldots (11)$$

in which the symbol ψ_T indicates a general functional relationship applicable to top take-offs.

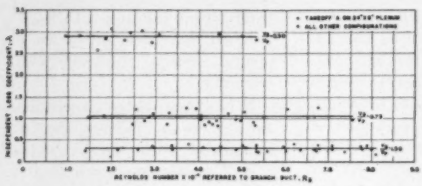

Fig. 6. Performance of take-offs as related to Reynolds number

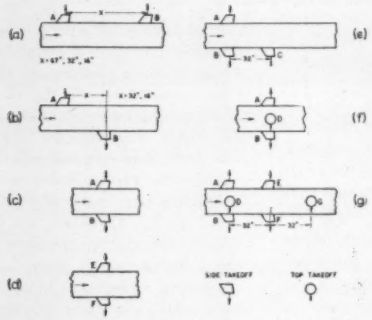

Fig. 8. Arrangements for studies of multiple take-offs

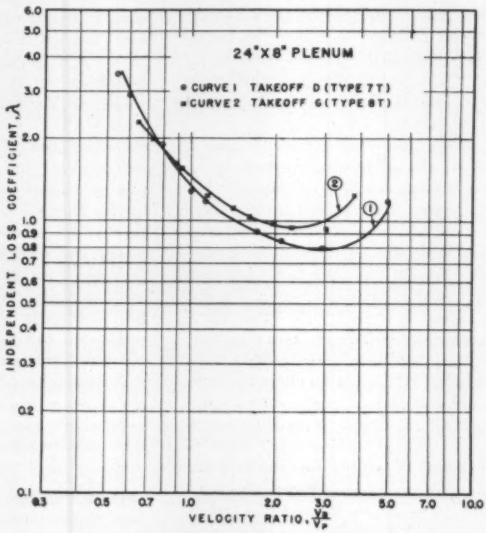

Fig. 7. Performance of two sizes of top take-offs

Results of Studies with Multiple Take-offs

Studies were conducted with two or more take-offs installed on the 24-in. × 8-in. extended plenum in order to determine the effect of the relative location of the take-offs. Each of the loss coefficients determined during these studies was designated the *interference loss coefficient* Θ. The difference between the independent loss coefficient λ and the interference loss coefficient Θ was designated the *take-off interference*. The take-off interference serves as an index of the change in the performance of a take-off due to its location in relation to the locations of other take-offs. During these studies, values of the take-off interference were obtained over the practical range of velocity ratios by adjusting the dampers on the various branch ducts and at the exit section of the plenum.

The number, types, and relative locations of the take-offs for each of the various arrangements studied are shown in Fig. 8, as follows:

1. *Arrangement in Fig. 8 — a:* These studies were conducted with two 7-in. diameter side take-offs located along the same side of the plenum. Take-off B was initially installed 67-in. downstream from Take-off A, and was then moved progressively closer to Take-off A. The maximum take-off interference for either take-off, expressed in terms of equivalent feet, was two feet of round duct. Therefore, it was concluded that there was negligible interference between two 7-in. diameter side take-offs due to their relative locations on the same side of the extended plenum.

2. *Arrangement in Fig. 8 — b:* Take-off A was fixed in place, and Take-off B was located at a distance of 32 in. or 16 in. downstream and on the opposite side of the plenum. The results showed that the performance of the downstream take-off was affected by the proximity of the upstream take-off. However, the take-off interference was only of the order of five equivalent feet of round duct. In contrast, the performance of the upstream take-off was not influenced by the relative locations of the downstream take-off.

3. *Arrangement in Fig. 8 — c:* When Take-offs A and B were located directly opposite each other, the maximum take-off interference for either take-off was only four equivalent feet of round duct.

4. *Arrangement in Fig. 8 — d:* In order to determine the effect of take-off size on the take-off interference, Take-offs E and F, which were 8 in. and 9 in. in diameter, respectively, were studied when located directly opposite each other. The take-off interference was greater than that for the 7-in. diameter take-offs shown in Fig. 8 c. However, the take-off interference for Take-off E or Take-off F did not exceed nine equivalent feet of round duct.

5. *Arrangement in Fig. 8 — e:* This is similar to the arrangement shown in Fig. 8 c except that an additional 7-in. diameter take-off was installed 32-in. downstream from Take-off B. The performance of the downstream take-off was not adversely affected by the presence of two take-offs upstream since the maximum take-off interference was equivalent to three feet of round duct.

6. *Arrangement in Fig. 8 — f:* From the standpoint of space limitations, the largest number of take-offs which would ordinarily be located on the plenum at a given cross section would be two side take-offs and one top take-off. This arrangement was studied with three 7-in. diameter take-offs. The results showed that, as before, the side take-offs did not interfere with each other. However, over the practical range of velocity ratios, the interference loss coefficient θ of the top take-off was *less* than its independent loss coefficient λ as shown in Fig. 9. The maximum effect of take-off interference as indicated in Fig. 9 represents a reduction of 13 equivalent feet of round duct. For practical purposes, the independent loss coefficient λ should be used and the safety factor represented by the *negative* takeoff interference ignored.

7. *Arrangements in Figs. 8 — c, 8 — d, and 8 — f:* Studies were also conducted with the 24-in. x 12-in. plenum in order to

determine the effect of plenum depth on take-off interference. No appreciable change in take-off interference resulted from the increase in plenum depth.

8. *Arrangement in Fig. 8 — g*: Studies were made with the 24-in. x 8-in. plenum in order to determine the interference of each take-off in a simulated practical system. The interference of the various take-offs was found to be in excellent agreement with those previously determined. In addition, the interference effect was not cumulative when a take-off was located downstream from several others. Studies were also made with the 24-in. x 12-in. plenum, and similar results were obtained.

These studies with multiple take-offs indicate that the independent loss coefficient defines the pressure loss of a take-off, and can be used in predicting the air flow rate of the branch duct. To verify this statement, special studies were conducted with the 24-in. × 8-in. plenum and with the simulated practical system in Fig. 8 g. A value of equivalent length was arbitrarily selected for each branch duct. The air flow rate in each branch duct was then predicted using the independent loss coefficients of the various take-offs. Next, the actual air flow rates in the branch ducts were measured and compared with the predicted values. In no case did the actual branch duct flow deviate from the predicted value by more than five percent and the average deviation was only two percent. Deviations of the same order were obtained during a similar study with the 24-in. × 12-in. plenum.

The results obtained from these studies with multiple take-offs show that interference due to the relative location of take-offs is negligible from a practical standpoint. Hence, there are no limitations on the relative location of the take-offs. Furthermore, the results show that the air flow rate in a branch duct can be predicted by means of the independent loss coefficient as determined by the velocity ratio at the point of take-off.

Practical Interpretation of Results

In the design of air duct systems it is usual practice to consider the pressure loss of a take-off in terms of *equivalent feet of round duct* or *equivalent diameters* rather than in terms of the dimensionless independent loss coefficient, λ. Furthermore, it is customary to use a single value of equivalent length to represent the loss of a take-off for systems such as the trunk duct system, whereas the results of this investigation have shown that this is not feasible for extended-plenum take-offs because the loss is dependent upon the velocity ratio. It is therefore desirable to express the performance of extended-plenum take-offs in terms of the equivalent feet of round duct as a function of velocity ratio.

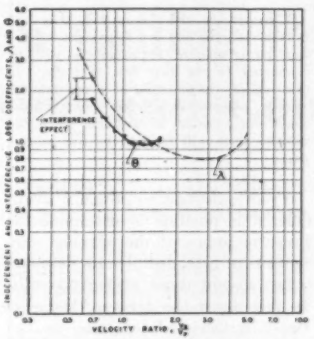

Fig. 9. The effect of interference on a take-off

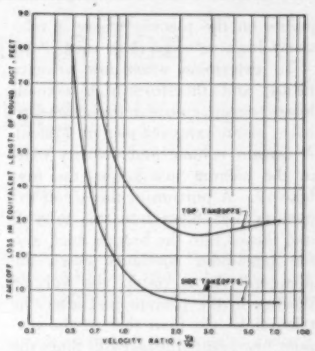

Fig. 10. Loss curves for side and top take-offs

In the preceding discussion, it was indicated that for *practical considerations* the performance of extended-plenum take-offs when expressed in terms of equivalent feet was not affected by the following:

1. Changes in the width of the extended plenum.
2. Changes in the depth of the extended plenum.
3. Variation in the size of side take-offs.
4. Variation in the size of top take-offs.
5. Proximity of other take-offs.

These factors indicate the possibility of establishing a single curve applicable to the side take-offs and another curve applicable to the top take-offs. Further analysis of this possibility proved that such curves could be drawn, and they are presented in Fig. 10. In no case does the actual pressure loss of any side or top take-off, as determined experimentally, exceed by more than five equivalent feet the loss obtained from the corresponding curve of Fig. 10. Since five equivalent feet of branch duct represents but a small fraction of the normal pressure loss of the complete duct system, it can be concluded that these curves can be utilized in designing extended-plenum duct systems having plenum and take-off sizes of the order of those investigated. The experimental results presented in Figs. 4, 5, 7, and 9 have been condensed in Fig. 10 to two curves relating take-off loss to velocity ratio.

Certain practical aspects can be illustrated using the curves of Fig. 10. Referring to the curve for side take-offs, the loss varies from 80 to 7 equivalent feet of branch duct, the larger loss being at the lower range of velocity ratios. For example, a branch velocity of 400 fpm and a plenum velocity of 800 fpm represent a velocity ratio of 0.5 and result in a take-off loss of 80 equivalent feet. In contrast, a branch velocity of 400 fpm and a plenum velocity also of 400 fpm represent a velocity ratio of 1.0 and a take-off loss of only 15 equivalent feet.

Referring to the curve for top take-offs in Fig. 10, the loss varies from 70 to 25 equivalent feet over the range of velocity ratios investigated, the larger loss being at the lower range of velocity ratios. It should be noted that at a given value of velocity ratio, the pressure loss of a top take-off is considerably greater than that of a side take-off. Therefore, top take-offs should be located at

points on the plenum where a relatively high velocity ratio exists.

To determine when low velocity ratios, and therefore high take-off losses, occur, consider the characteristics of an extended-plenum system. A certain volume and velocity exist in the plenum just before the first take-off. A portion of the air in the plenum then flows into this take-off and thence into the branch duct, and the remainder continues down the plenum. As a result, the volume flowing in the plenum just after the take-off is less than that in the plenum just before the take-off. Since the area of the plenum is constant throughout its length, the plenum velocity decreases after each take-off. Current residential practice is to use design velocities of from 700 to 900 fpm for the sections of the plenum close to the conditioner.[3] The plenum velocity may therefore be as high as 900 fpm at the first take-off and 100 fpm or less at the last take-off. Since the design velocities for branch ducts of residential systems are generally of the order of 600 fpm,[3] it is evident that low velocity ratios and large losses are characteristic of the first few take-offs, and high velocity ratios and small losses are characteristic of the last few take-offs on an extended plenum. This indicates that during the design process careful consideration should be given to the first few take-offs.

Whenever possible, velocity ratios for side take-offs should be greater than 0.70 in order that the resulting take-off loss will not exceed 35 ft of round duct. In addition, velocity ratios for top take-offs should be greater than 1.0 to provide losses less than 45 ft of round duct. If, during the design of an extended-plenum system, these conditions of velocity ratios are not met, one or more of the following changes in the system should be considered:

1. Increase the plenum size, to decrease the plenum velocity. This provides a higher velocity ratio and a smaller take-off loss.

2. Increase the branch duct velocity by increasing the air flow rate in the branch, or by decreasing the size of the branch duct. This may require a slightly higher pressure in the plenum.

3. Rearrange the layout so that the branch ducts having low equivalent lengths and large volume requirements will be connected to the first few take-offs. In this regard, the location of a top take-off on the plenum at a point close to the conditioner should be avoided, since the velocity ratio will tend to be low at this point.

From information already available, it is possible to determine the pressure losses of the various components of extended-plenum duct systems[3], except those of the take-offs. In this paper the pressure losses of standard side and top take-offs can be evaluated from the curves of Fig. 10, and, therefore, sufficient information is now available for designing extended-plenum duct systems for residential and small commercial applications.

Conclusions and Recommendations

For the range of take-offs and extended plenums studied in this investigation, the following conclusions and recommendations can be made:

1. The independent loss coefficient, λ, is a function of velocity ratio, but is not a function of length ratio and Reynolds number.

2. The independent loss coefficient of a side take-off is not affected by the size or shape of the extended plenum, the size of the take-off, or the location on the plenum relative to other take-offs. This statement also applies to a top take-off.

3. For a given velocity ratio, the pressure loss of a top take-off is much greater than that of a side take-off.

4. The pressure losses of both side and top take-offs vary over a wide range, and are exceedingly large for low values of velocity ratios. Therefore, low values of velocity ratio should be avoided whenever possible.

5. For practical purposes, the relationship between pressure loss and velocity ratio is given by a single curve that applies to all side take-offs. Another curve provides this relationship for all top take-offs.

6. Careful consideration should be given to the design of branch ducts located near the conditioner in view of the possibility of obtaining low values of velocity ratio and resulting high values of take-off loss.

7. In order to avoid excessive take-off losses, the branch duct size, take-off location, and plenum size should be selected to maintain values of velocity ratio greater than 0.7 for side take-offs and greater than 1.0 for top take-offs.

Acknowledgment

This paper is a report of a laboratory investigation conducted under the terms of a cooperative research agreement between the Committee on Domestic Gas Research of the *American Gas Association* (AGA Project DGR-2-AC) and the *Engineering Experiment Station* of the *University of Illinois*. The overall objective of this research program has been the improvement of air distribution systems for all-year gas air conditioning. The results of research previously completed under the terms of this agreement have been reported.[4,5,6] Acknowledgment is made to the AGA Technical Advisory Group for Heating and Air Conditioning Research for the advice and counsel received.

Acknowledgment is also made to W. B. Meyer, Laboratory Technician, J. S. Brown and E. R. Archambeau, former graduate students, and H. A. Larson, Research Assistant, for their help in collecting and reducing the data. The material presented in this paper will ultimately comprise part of a bulletin of the *University of Illinois Engineering Experiment Station*.

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Aluminum Ceiling Panels for Heating and Cooling

By E. S. Howarth*, S. C. Huddleston**, and R. M. Koch**, New Kensington, Pa.

SUMMARY — Results of Heating and Cooling Tests conducted on a variety of brazed aluminum ceiling panels are presented for a number of panel and room operating conditions. An analytical solution concerning the thermal performance of metal heating and cooling panels is developed and this is reduced to a design chart for easy applications to panels differing markedly from those tested. Comparisons drawn between the actual test results and those predicted by the analytical solution indicate good agreement.

DESIGNERS of modern air-conditioned buildings are confronted with the problem of providing, at reasonable cost, adequate heating, ventilating, and air conditioning facilities through the use of equipment and arrangements which will conserve the greatest amount of space for other purposes. In solving this problem in a 30-story office building being constructed for the Aluminum Company of America in Pittsburgh, Pa., investigation was made of a multipurpose aluminum ceiling for heating, for partially cooling, and for accomplishing the desired acoustical treatment. In addition to providing the advantages of ceiling-panel heating, this installation will employ ceiling-panel cooling in a similar manner, thus relieving the air conditioning system of a large portion of its normal load. The resulting reduction in size of air handling equipment and ducts, the efficient use of ceiling area, and certain construction innovations adopted are expected to increase the net usable space by an amount equivalent to about one and one-half stories.

Aluminum ceiling panels offer certain advantages when compared with panels composed of water-carrying tubes embedded in plaster or concrete. The high thermal conductivity of aluminum permits wide spacing of the water-carrying tubes and obtains a temperature of the effective face of the panel approaching that of the water in the tube. The latter consideration makes panel cooling practicable because the temperature of the chilled water can be above the dewpoint of the ambient air and still provide effective cooling. The aluminum panels respond rapidly to quick changes in water temperature and are not subject to the cracking hazards. Acoustical treatment is accomplished readily with no adverse effect on thermal performance by perforating the sheet elements of the panels and overlaying them with glass wool blankets in a manner common to metal acoustic ceilings.

A search of the literature revealed that considerable information concerning the design and thermal performance of radiant plaster panels was available from the work of Raber, Hutchinson, Vanderweil, Giesecke, and others. With the exception of a paper[1] by Leopold, dealing with the cooling performance of ceiling mounted aluminum plates having integral water passages, little technical information relating to metal ceilings for heating and cooling was found. Consequently, a program of tests was initiated to determine not only the heating and cooling performance of such ceilings, but also to indicate the relative effects of variations in design details and operating conditions upon thermal performance.

During the early stages of designing the Alcoa Office Building, consideration was given to the use of aluminum ceiling panels in which the water-carrying elements were an integral part of the ceiling or were either bonded or mechanically attached to it. Bonded construction, in which ceiling surface and water-carrying elements were brazed together, seemed to offer the best combination of fabrication, installation, and thermal characteristics. The test

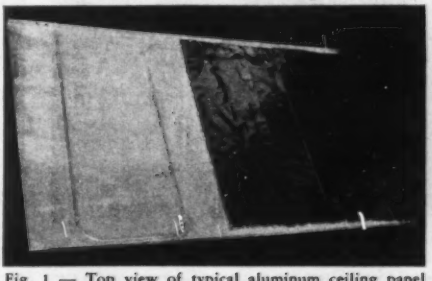

Fig. 1 — Top view of typical aluminum ceiling panel —20-in. tube spacing

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**Research Engineer, Aluminum Research Laboratories, Aluminum Company of America.

Presented at the Semi-Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Portland, Ore., July, 1951.

[1]The Mechanism of Heat Transfer, Panel Cooling, Heat Storage, by Charles S. Leopold (*Refrigerating Engineering*, July 1947, p. 33).

results reported in this paper were obtained from such brazed panels, but the analytical procedure is not in any way limited to that type of construction. In fact, the ceiling selected for the building is being constructed of relatively small aluminum pans having integral clips which attach the pans mechanically to the water-carrying pipes. The theory and design data presented in this paper have been applied to them with good results.

Description of Tests

The experimental phase of the investigation involved the testing of several designs of ceiling panels, each of which, in general, consisted of a sheet of aluminum to the top side of which was brazed aluminum tubing tracing a sinuous path across the panel. Most of the tests were performed on panels in which the facing sheet was 1/8 in. thick. However, tests were also conducted on panels having facing sheet thicknesses of 3/32 and 1/2 in. Five panel designs were tested in which adjacent tube passes were spaced on 8-in. centers, and seven designs involved tubes spaced on 20-in. centers. The emissivity of the panel surfaces was varied by different surface treatments, namely, ivory paint (94 percent), anodic oxide coating (91 percent), lacquer (69 percent), aluminum paint (33 percent), and bare aluminum (4 percent). The thermal conductivity of the 3S aluminum facing sheets was determined by test to be 86 Btu per (hr) (sq ft) (F deg per ft). Each panel was 4 ft - 3 in. wide by 7 ft - 0 in. long and two such panels were assembled to make a continuous 14-ft long section. The aluminum tubing had a 5/8-in. outside diameter and a wall thickness of 0.065 in. The tests were conducted with an insulating layer on the top side of the panel consisting of a 1-in. thick blanket of glass wool covered on the top only by aluminum foil. Fig. 1 shows the top side of a typical panel, showing insulation and tubing. Only a small percentage of the panels tested were perforated.

Fig. 2 — Interior view of one corner of the test room

The 14-ft long panel assemblies were tested, two at a time, while suspended from the ceiling of a specially constructed test room, one corner of which is shown in Fig. 2. The totally-enclosed test room was designed to represent the size of a typical office and measured approximately 12 ft by 16 ft by 8-1/2 ft high. The walls, floor, and ceiling were insulated with thick rock wool batts. The finished floor was wood and the walls were faced with insulating wall board. Fluorescent fixtures, recessed flush with the ceiling panel surfaces, provided a lighting load of 3 watts per sq ft of floor area.

Nominal room air temperatures of 70 F for heating tests and 80 F for cooling tests were maintained by circulating air through the room. Air temperature control was obtained by employing external air conditioning equipment and pneumatic type temperature controllers. With this equipment the local variation in air temperature with time was held to within ±1 deg.

Water at any desired temperature was supplied to the panels by an external system of pumps and heat exchangers and water temperature variation was held to within ± 0.1 deg through the use of several pneumatic-type temperature controllers.

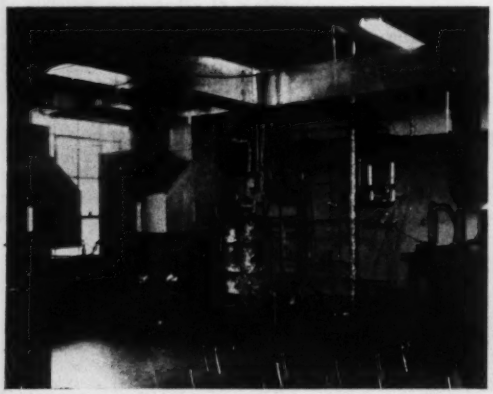

Fig. 3 — External view of test room, air conditioning, and water control equipment

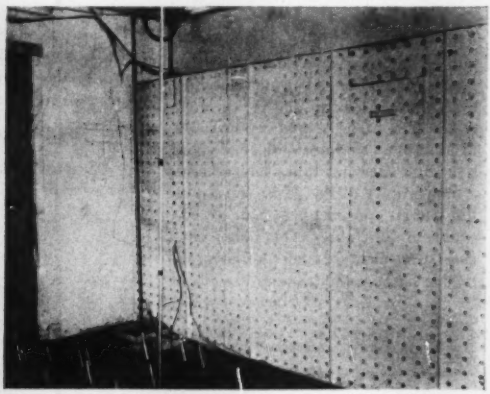

Fig. 4 — Internal view of one corner of test room showing perforated air diffusing partition

Table 1 — Summary of Aluminum Heating and Cooling Panel Performance†

NOMINAL INLET WATER TEMP			q_A = PANEL THERMAL PERFORMANCE, BTU/(HR)(SQ FT)[7]															
			HEATING[3]												COOLING[4]			
			180° F				160° F				120° F				60° F			
NOMINAL AIR VELOCITY[2]			25 fpm		< 10 fpm		25 fpm		< 10 fpm		25 fpm		< 10 fpm		25 fpm		< 10 fpm	
NOMINAL WATER FLOW RATE			1 gpm	¼ gpm	1 gpm	¼ gpm	1 gpm	¼ gpm	1 gpm	¼ gpm	1 gpm	¼ gpm	1 gpm	¼ gpm	1 gpm	¼ gpm	1 gpm	¼ gpm
TUBE SPACING	FACE SHEET THICKNESS	SURFACE EMISSIVITY																
6"	1/8"	94%	176 182		147 142	110 107	138 147		114 115	87 87			49 51	41 48	-28 -29		-28 -28	-18 -19
		[1] 94%	180 182	126 128			140 147	98 104			73 78	48 55			-30 -29	-20 -20		
		91%	180 181	121 128	140 140	104 104	144 146	101 104	104 113	82 88	77 77	52 55	50 50	38 43	-25 -29	-20 -20	-23 -28	-18 -19
		69%	167 169	113 122	127 122	98 97	131 137	97 99	109 99	82 78	74 72	50 52	59 52	39 41	-20 -27	-19 -19	-22 -26	-17 -19
		[1] 33%	138 149		103 93		128 121		75 77	55 64			36 41		-20 -24		-28 -25	
20"	3/8"	94%			120 107	97 88	121 107		97 87	76 69			51 46	38 36	-20 -21		-21 -20	-16 -16
		[1] 94%	136 132	108 98			111 107	82 79			59 57	44 42			-23 -21	-18 -16		
		91%	132 131	100 98	119 107	93 84	107 106	84 79	94 87	70 68	51 50	43 42	45 44	36 36	-23 -21	-18 -16	-24 -25[8]	-18 -19[8]
		69%	130 123	105 93			110 101	88 76			56 54	43 40			-22 -22	-17 -16		
20"	3/32"	33%							68 60	56 50								
		4%			61 53	57 56			53 51	42 45			30 27	22 24			-16 -23[8]	-13[8] -12
20"	1/8"	94%			134 133	103 99			119 108	91 90			61 57	41 42			-33 -29[8]	-19 -19[8]

†All panels 4 ft 3 in. × 14 ft 0 in. except 3/32 in. thick panels which were 4 ft 3 in. × 13 ft 6 in.; all insulated with 1 in. thick glass wool blanket covered with aluminum foil on the top side

(1) These panels perforated over entire surface with ⅛ in. diameter holes on ½ in. centers (perforations occupy 5 percent of total panel area)

(2) Near face of panel

(3) t_A = 70 F, t_T = 75 F

(4) t_A = 80 F, t_T = 77 F (except as noted)

(5) t_T = 79 F

(6) t_T = 81 F

t_A = Average controlled room air temperature

t_T = Mean wall and floor temperature

(7) Test results shown — 176, 147, etc.
Analytical results shown—182, 142, etc.

Water flow rate was indicated by a calibrated flow measuring instrument. A general view of the external test room equipment, including air conditioning system, water temperature control system, and measuring instruments, is presented in Fig. 3.

Temperature measurements were made by means of calibrated iron-constantan thermocouples and a self-balancing electronic potentiometer employing a melting ice cold junction. Air temperature measuring thermocouples which could *see* the panels were shielded with aluminum foil to minimize direct radiation effects. Thermocouples were located at numerous points on the walls and floor of the test room and at ten different locations along the 14-ft centerline of each panel assembly. Other couples were suspended in the air at a number of points below and above the panels. Inlet, outlet, and intermediate water temperatures were measured. Each temperature survey involved approximately 60 measurements.

Air was circulated through the room at a rate of approximately 880 cfm, which was about equivalent to one change every 2 min. This rate was necessary to remove the heat released by the panels in order that the room air temperature would remain constant. Part of the tests were made with the inlet air grille louvers adjusted half up and half down. With this arrangement the air velocity across the face of the panel was measured with an anemometer at 30 locations on the two panels when cold, and the average velocity was found to be about 25 fpm. To obtain air conditions within the room that would more closely approximate the conditions set up by natural convection, a perforated diffuser partition was erected in front of the inlet air grilles. With the partition in place no indication of air motion anywhere in the room was obtained with the anemometer, although calibration data were available for velocities as low as 10 fpm. Therefore, it was concluded that for the tests made with this setup the air velocity across the surface of the panels was less than 10 fpm.

The interior corner of the test room, shown in Fig. 2, reveals portions of the ceiling panels with surface temperature measuring thermocouples attached, several wall thermocouples, the standards supporting the air temperature measuring thermocouples, the thermocouple junction box, and one of the inlet air grilles. Fig. 4 is a view of this same corner of the test room with the perforated diffuser partition in place.

Tests were conducted employing inlet water temperatures of 180, 160, and 120 F for heating and 60 F for cooling. Water flow rates were established at either 1 or ¼ gpm. Test data were not recorded following a change in test conditions until equilibrium was reached and then three consecutive series of observations were made at about 10 min intervals.

Results of Tests

The thermal performance of each panel under the various test conditions was calculated from the rate at which heat was released from, or

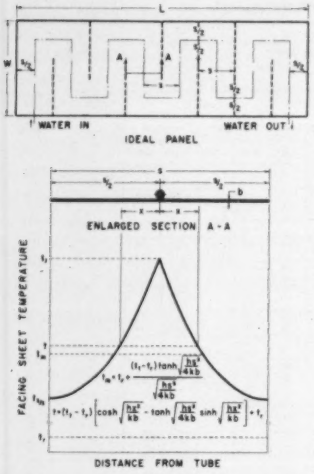

Fig. 5 — Idealized panel with temperature distribution at typical cross section

absorbed by, the water as it flowed through the panel. Dividing this heat rate, Q, expressed in Btu per hour, by the room-side panel face area, A, in square feet, resulted in the average unit panel performance, Q/A, expressed as Btu per (hr) (sq ft). This index to panel performance includes the relatively small amount of heat transmitted through the insulating blanket on the top side of the panel.

A summary of the thermal performance results obtained from 89 heating tests and 30 cooling tests is presented in Table 1. The upper number in each block represents the average thermal performance, Q/A, obtained from three consecutive series of observations made under equilibrium conditions. From this summary, the effects of variations in panel design and operating conditions upon the thermal performance of the panel can be observed. It is important to note that improved thermal performance resulted from increasing face sheet thickness, surface emissivity, water flow rate, and air velocity, and from decreasing tube spacing. For the heating tests, raising the inlet water temperature resulted in a pronounced increase in thermal performance. Although not shown in Table 1, a similar improvement was observed for cooling tests in which the temperature of the inlet water was decreased below 60 F.

Interesting cross comparisons can also be made in Table 1. For example, it can be seen that, for the lower air velocity, introduction of 160 F water at 1 gpm resulted in almost the same heat output as was obtained for 180 F water at 1/4 gpm. This suggests the use of water flow rate as well as water temperature as a means of controlling panel performance.

Further examination of the test results shown in Table 1 indicates that, for identical water flow rates, air velocities, face sheet thickness, and surface emissivities, panels having a tube spacing of 8 in. exhibited practically the same thermal performance for 160 F inlet water as did 20-in. tube space panels when the inlet water temperature was 180 F. Similarly, increasing the facing sheet thickness from 1/8 in. to 1/2 in. nearly compensated for an increase in tube spacing from 8 to 20 in.

In calculating the performance of the perforated panels, it was originally intended to consider only the net face area of the facing sheet. An analysis of the test results, however, revealed that no correction should be made for the loss in face area due to the perforations. Consequently,

Nomenclature

W = width of panel, feet.
L = length of panel, feet.
A = room-side face area of panel, square feet.
b = thickness of panel facing sheet, feet.
D = developed length of tube, feet.
s = distance between centerlines of adjacent tube passes, (also called tube spacing), feet.
Sec. A-A = a typical cross section of the panel taken normal to the tube and extending in width a distance $s/2$ on each side of the tube.
x = shortest distance from any point on the face of the panel to the centerline of the tube projected to the face of the panel, feet.
y = distance from water inlet edge of the panel to Section A-A as measured along the tube, feet.
dy = small increment of y, feet.
1,2 = subscripts used to relate temperature to the inlet and outlet edges of the panel, respectively.
Q = rate at which total heat is released from or absorbed by the entire panel, Btu per hour.
$q_{A\text{-}A}$ = rate at which total heat per unit area is released from or absorbed by the panel at Section A-A, Btu per (hour) (square foot).
G = water flow rate, gallons per minute.
w = water flow rate, pounds per hour.
p = specific heat of water, Btu per (pound) (Fahrenheit degree).
k = thermal conductivity of facing sheet material, Btu per (hour) (square foot) (Fahrenheit degree per foot).
ϵ = emissivity of panel surface, percent.
e = Naperian constant, 2.718.
t_a = average temperature of room air, Fahrenheit.
t_r = weighted mean temperature of room air, walls, and floor, including space and structure above panels, (approximated by considering only the temperatures of the room walls and floor), Fahrenheit.
t_w = temperature of the water at any point a distance, y, along the tube, Fahrenheit.
t = temperature of the facing sheet at any point, Fahrenheit.
t_t = temperature of the facing sheet at any point directly under the centerline of the tube a distance, y, along the tube, Fahrenheit.
$t_{s/2}$ = temperature of the facing sheet at a distance $s/2$ from the tube, Fahrenheit.
t_N = arithmetic weighted average of all temperatures, t_t and $t_{s/2}$, observed on the longitudinal centerline of the panel, Fahrenheit.
t_n = arithmetic average of temperatures, t_t and $t_{s/2}$, at Section A-A, Fahrenheit.
t_M = mean temperature of the entire panel surface, Fahrenheit.
t_m = mean temperature of the panel surface at Section A-A, Fahrenheit.
c = heat transfer coefficient for the flow of heat from the water in the tube through the water film and metallic joint to the panel surface directly under the tube, Btu per (hour) (foot of tube) (Fahrenheit degree).
h = general heat transfer coefficient combining radiation, convection, and conduction, and relating heat flow to the difference between the first powers of t and t_r, Btu per (hour) (square foot) (Fahrenheit degree).
h_N = approximate heat transfer coefficient obtained from panel tests by relating average unit heat transfer rate, Q/A, to temperature difference between t_N and t_r, Btu per (hour) (square foot) (Fahrenheit degree).
h_M = adjusted heat transfer coefficient obtained from h_N by correcting for the difference between t_N and t_M, Btu per (hour) (square foot) (Fahrenheit degree). Represents experimentally determined h.
h' = modified heat transfer coefficient for Section A-A referred to temperature, t_t, directly under the tube, Btu per (hour) (square foot) (Fahrenheit degree).
h'' = modified heat transfer coefficient for Section A-A referred to water temperature, t_w, Btu per (hour) (square foot) (Fahrenheit degree).
h''' = overall heat transfer coefficient for the entire panel referred to the inlet water temperature, t_{w1}, Btu per (hour) (square foot) (Fahrenheit degree).

$$R = \frac{\tanh\sqrt{\frac{s^2h}{4kb}}}{\sqrt{\frac{s^2h}{4kb}}}$$

(tanh is the hyperbolic tangent).

plain and perforated panels were treated alike in calculating the performance values shown in Table 1. Even then, the thermal performance of perforated panels exceeded slightly that of plain panels in four of the five cases in which direct comparisons can be drawn. It is believed that the cylindrical surface inside each perforated hole compensated for the loss in face area. Such a balance might not result for other combinations of face sheet thickness, hole size, and spacing.

Efficient transfer of heat through the brazed joint resulted in relatively small temperature differences between water in the tube and face sheet immediately under the tube. The average temperature difference for all heating and cooling tests, excluding those conducted on the somewhat impractical panel with the ½-in. thick face sheet, was 2.4 deg. This subject is discussed in more detail later.

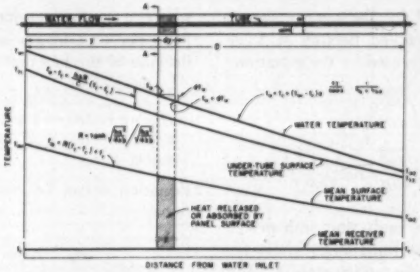

Fig. 6 — Developed single tube panel with temperature distribution curves

Theoretical Analysis

Direct application of test results is usually complicated by differences between test and service conditions. This is particularly true when performance is affected in varying degrees by as many variables as are associated with this problem. The following analytical procedure, therefore, has been developed for use in applying the preceding test results to a wider variety of ceiling panels and operating conditions than were included in the tests.

In this analysis, the nomenclature employed, and the units of measure are as indicated unless otherwise noted.

Maximum heating and cooling performance of water-carrying ceiling panels having fixed surface characteristics would be attained if the surface temperature of the panel t were uniform throughout and equal to the temperature of the entering water, t_{w1}. This condition would result if it were possible to flow a sheet of heated or chilled water at infinite velocity over the top surface of a metal panel having no resistance to heat transfer through its thickness. Such maximum performance is partially sacrificed, in the tube-and-sheet type panels with which this paper is concerned, to gain other advantages. For example, conveying the water in tubing attached to the facing sheet provides ample space for acoustical perforations. Control of the water flow rate causes a change in thermal performance of the panels and can be applied to advantage due to the manner in which the performance requirements vary with respect to distance from outside building walls.

The tubing and facing sheet could be joined by brazing, welding, soldering, adhesive bonding, or mechanical connections. The temperature difference between the water and the facing sheet directly under the tube would be affected by the thermal resistance of such joints. Consequently, in this analysis, a coefficient c is used for the rate of flow of heat from the water in the tube through the water film and metallic joint to the panel surface directly under the tube.

The rate at which heat is released or absorbed by every unit area of a panel having a uniform surface temperature t can be expressed as,

$$Q/A = h(t - t_r) \quad \text{----------(1)}$$

and the value selected for the heat transfer coefficient h depends upon considerations given to air motion, surface emissivity, insulation above the panel, and the general level of temperatures t and t_r.

For an aluminum tube and sheet panel in which tube spacing s, the facing sheet conductance bk, and water flow rate G have finite values, the face sheet temperature, t, varies with distance along as well as away from the tube. As was the case for the uniform temperature panel, the heat transfer coefficient h might be affected by the general level of the mean surface temperature, t_M, but it is assumed that a single value of h can be used for the entire panel. In order to calculate the thermal performance of such a non-uniform temperature panel, it is necessary to determine the temperature distribution on the panel surface.

Consider, therefore, an idealized type of heating panel, such as the one shown in the upper part of Fig. 5, in which the tube traces a square-cornered sinuous path. The marginal distance $s/2$ at all ends and edges of the panel is one-half the tube spacing s. The facing sheet is slit midway between adjacent parallel tube passes, as shown by the dashed lines. Straightening the sinuous tube to its developed length D results in the single straight tube panel shown in the upper part of Fig. 6. Inasmuch as this represents one element of a parallel grid system, the analysis presented here applies to either parallel or series flow arrangement of the water-carrying tubes.

Section A-A, as shown in the lower part of Fig. 5, represents a typical cross section of the idealized or straight tube panel. In effect, the facing sheet now becomes two symmetrical fins attached to the tube. Mathematical consideration of the heat flow through and from each fin results in the temperature distribu-

tion indicated by the curves shown under the enlarged Section A-A in Fig. 5 and expressed by the equation,

$$t = (t_r - t_r)\left[\cosh\sqrt{\frac{hx^2}{kb}} - \tanh\sqrt{\frac{hs^2}{4kb}}\sinh\sqrt{\frac{hx^2}{kb}}\right] + t_r \quad (2)$$

in which cosh, tanh, and sinh designate hyperbolic functions. Similarly, the mean surface temperature, t_m, for Section A-A can be expressed in the equation,

$$\frac{(t_m - t_r)}{(t_t - t_r)} = \frac{\tanh\sqrt{\frac{s^2h}{4kb}}}{\sqrt{\frac{s^2h}{4kb}}} = R \quad \cdots\cdots (3)$$

The rate at which total heat per unit area is released from the panel at Section A-A is,

$$q_{A\text{-}A} = h(t_m - t_r) \quad \cdots\cdots (4)$$

which can be expressed,

$$q_{A\text{-}A} = hR(t_t - t_r) \quad \cdots\cdots (5)$$

During heating service, the temperature of the water, t_w, decreases as the water flows through the tube and this results in a similar decrease in panel surface temperatures, t_t and t_m, as indicated by the curves in the lower part of Fig. 6. Consequently, the rate of total heat output per unit area, $q_{A\text{-}A}$, also decreases from the inlet to outlet end of the panel, and it is necessary to integrate this effect along the tube in order to determine the thermal performance of the entire panel.

The water, in passing through the incremental length of panel, d_y, shown in Fig. 6, loses an amount of heat equal to that released by this short length of panel. This condition is expressed by the differential equation,

$$-wp\frac{dt_w}{dy}dy = hs(t_m - t_r)dy \quad \cdots (6)$$

and in terms of the temperature drop $(t_w - t_t)$, across the joint,

$$-wp\frac{dt_w}{dy}dy = c(t_w - t_r)dy \quad \cdots\cdots (6a)$$

where c is the conductance of the joint per unit length of tubing. Because of the fact that:

1. $wp = 500G$
2. $hs\ (t_m - t_r) = c\ (t_w - t_t)$, by combining Equations 6 and 6a
3. $(t_m - t_r) = R\ (t_t - t_r)$, from Equation 3

Equation 6 can be converted to the form,

$$-500G\frac{dt_w}{dy} = \frac{hsRc}{hsR + c}(t_w - t_r) \quad \cdots\cdots (6b)$$

Solution of this differential equation results in the following expression for t_w at any distance y measured along the tube from the inlet end where $t_w = t_{w1}$,

$$t_w = t_r + (t_{w1} - t_r)e^{-\frac{sy}{500G}\cdot\frac{hRc}{hRs+c}} \quad \cdots\cdots (7)$$

From this it follows that, at the outlet end of the panel,

$$t_{w2} = t_r + (t_{w1} - t_r)e^{-\frac{sD}{500G}\cdot\frac{1}{s/c + 1/hR}} \quad \cdots\cdots (8)$$

Under equilibrium conditions, heat is released from the entire panel at the same rate as it is lost by the water; consequently,

$$Q = 500G(t_{w1} - t_{w2}) \quad \cdots\cdots (9)$$

Combining Equations 8 and 9,

$$Q = 500G(t_{w1} - t_r)\left(1 - e^{-\frac{sD}{500G}\cdot\frac{1}{s/c + 1/hR}}\right) \quad \cdots (10)$$

The average rate of heat output per unit area for the straight tube panel becomes,

$$\frac{Q}{A} = \frac{500G}{sD}(t_{w1} - t_r)\left(1 - e^{-\frac{sD}{500G}\cdot\frac{1}{s/c + 1/hR}}\right) \quad \cdots\cdots (11)$$

and for the sinuous tube panel,

$$\frac{Q}{A} = \frac{500G}{WL}(t_{w1} - t_r)\left(1 - e^{-\frac{WL}{500G}\cdot\frac{1}{s/c + 1/hR}}\right) \quad \cdots\cdots (12)$$

in which R is a function of h, s, k, and b, as indicated in Equation 3.

The rate of heat transfer is most commonly expressed by a coefficient times a temperature difference. Thus, for a uniform temperature panel for which the rate of heat transfer is expressed by Equation 1, the coefficient is h and the temperature difference is $(t - t_r)$.

The rate of heat transfer per unit area at any Section A-A of a tube and sheet panel is expressed by Equation 5 in which the coefficient, which will be denoted by h', is hR and the temperature difference is $(t_t - t_r)$. Note that in this case, t_t is the temperature at only one point in the section and that the reduction factor R is imposed upon the general coefficient h to compensate for the fact that for panel heating, all other points in the section are at temperatures lower than t_t. The coefficient, h', which applies to the temperature difference $(t_t - t_r)$ can, therefore, be stated as,

$$h' = hR = h\frac{\tanh\sqrt{\frac{s^2h}{4kb}}}{\sqrt{\frac{s^2h}{4kb}}} \quad \cdots\cdots (13)$$

and Equation 5 becomes,

$$q_{A\text{-}A} = h'(t_t - t_r) \quad \cdots\cdots (14)$$

The heat transfer rate per unit area at any Section A-A can also be expressed in terms of the temperature difference, $(t_w - t_r)$, by defining the coefficient, h'', which is actually the sum of the thermal coefficient of conductance of the joint plus the coefficient, h'. So,

$$h'' = \frac{1}{s/c + 1/h'} \quad \cdots\cdots (15)$$

and

$$q_{A\text{-}A} = h''(t_w - t_r) \quad \cdots\cdots (16)$$

For the entire tube and sheet panel, the average rate of heat transfer per unit area can be expressed as,

$$Q/A = h'''(t_{w1} - t_r) \quad \cdots\cdots (17)$$

In this case, the temperature t_{w1} is higher for panel heating than the temperature at any other point in

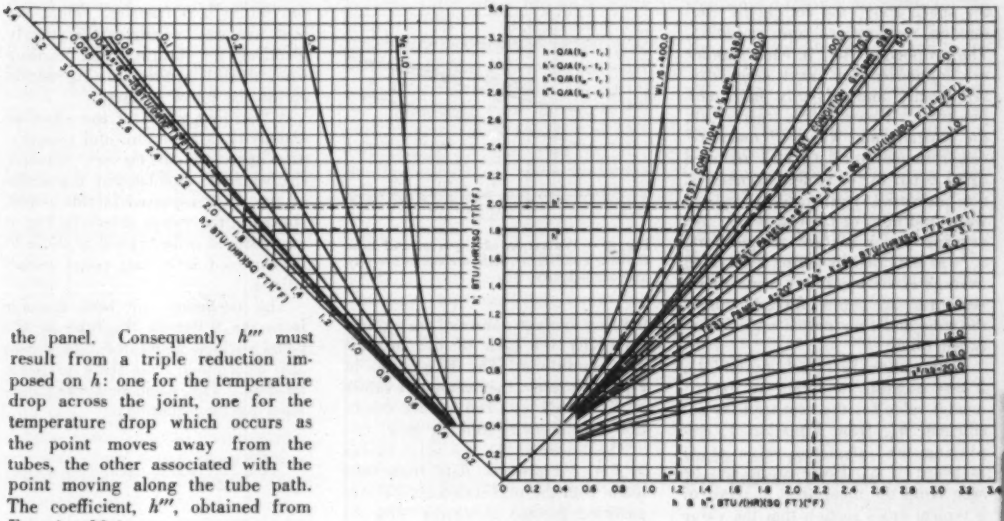

Fig. 7 — Design chart for aluminum ceiling panels

the panel. Consequently h''' must result from a triple reduction imposed on h: one for the temperature drop across the joint, one for the temperature drop which occurs as the point moves away from the tubes, the other associated with the point moving along the tube path. The coefficient, h''', obtained from Equation 12 is,

$$h''' = \frac{500G}{WL}\left(1 - e^{-\frac{WL}{5000}\cdot\frac{1}{s/c + 1/hR}}\right) \quad \text{---(18)}$$

From this it can be seen that the first reduction operates through the relationship between the tube spacing s and the joint conductivity c, the second reduction operates through R, and the third reduction is a function of the relationship between water flow rate G and the area of the panel WL.

Use of Equations 17 and 18 permits calculation of the average rate of total heat output per unit area for a panel through the substitution of values for all pertinent design and operating factors. Whereas the analysis was developed on the basis of panel heating, it applies equally well to panel cooling, in which case the heat flow would be a negative quantity.

In order to apply Equations 17 and 18, proper values must be determined for c in terms of flow rate and temperature and for h in terms of surface emissivity, air flow, and insulation above the panel. Analytical determination of these factors is not within the scope of this paper, but the values obtained from tests are presented later.

Design Chart

Calculation of h''' by using Equations 13, 15, and 18 is somewhat tedious and it is difficult to sense the relationship between h''' and h as determined by the other variables. Unfortunately, the reduction factors previously discussed are, in themselves, functions of h as well as the other variables, but fortunately the reducing operation can be accomplished readily in three steps. The design chart presented in Fig. 7 can be used for this purpose.

Example 1. Calculate the overall heat transfer coefficient referred to inlet water temperature for a panel operating under the following conditions: s = 8 in. = 2/3 ft; k = 86 Btu per (hr) (sq ft) (F deg per ft); b = 1/8 in. = 1/96 ft; c = 15 Btu per (hr) (ft of tube) (F deg); W = 4.25 ft; L = 14.00 ft; G = 1/4 gpm.

Solution. In order to use the design chart, Fig. 7, it is first necessary to calculate s^2/kb, s/c and WL/G which will be 0.5, 0.044 and 238, respectively.

If it is assumed that h is known, h''' can be obtained from the design chart by following the course indicated by the dashed lines. The chart is entered from the right hand abscissa at the value of h, such as 2.15 for the example. The vertical dashed line is followed until it intersects the curve for which s^2/kb = 0.5, at which location it can be observed that h' = 1.97 on the ordinate. This ordinate line is followed to the left until it intersects the curve for s/c = 0.044. By dropping vertically to the inclined base line, h'' is found to be 1.81. Proceeding horizontally to the right to intersect the curve for WL/G = 238 and dropping vertically, the value of h''' = 1.22 is found on the abscissa. This value for h''' is approximately 57 percent of that assumed for h.

Example 1 was selected as representing one of the test panels and will be referred to later when the heat output of the panel is calculated.

Experimental Determination of Heat Transfer Coefficients, h and c

The theoretical analysis can now be checked with the experimental results, but the experimental data must first be reduced to the terms of the theory.

The choice of an experimental value for the mean heat receiver temperature, t_r, is a difficult one, since t_r should actually be a weighted mean of several air and surface temperatures. Heat is lost from the panel to the room air by convection, to the walls and floor by radiation, and to

the space above the ceiling by conduction, convection, and radiation. The proportions lost in each manner are influenced by panel emissivity, air velocity, and probably panel temperature. However, in this work, the experimental value of mean receiver temperature, t_r, was assumed to be equal to the weighted mean of ten measured temperatures on the walls and floor of the test room. An average panel surface temperature, t_N, was obtained by taking a weighted average of six measured surface temperatures at points directly under the tube and four points midway between tubes.

With values for Q/A, t_r, and t_N, it was possible to obtain an experimental value for the heat transfer coefficient, h_N, from Equation 1, employing the calculated value of t_N in place of t. However, it can be seen from the theoretical analysis of a typical cross section that the value of average surface temperature, t_n, may be considerably different from the actual mean surface temperature t_m because the temperature distribution between tubes follows a logarithmic path rather than the straight line assumed in determining t_n. Therefore, a relationship between the actual mean surface temperature t_m and the measured average temperature t_n was determined from Equation 2, and a similar relationship was assumed to exist between temperature t_M and t_N for the whole panel. Thus:

$$\frac{t_n - t_r}{t_s - t_r} = \frac{2\sinh\sqrt{\frac{s^2h}{4kb}}}{\sqrt{\frac{s^2h}{4kb}}\left(1+\cosh\sqrt{\frac{s^2h}{4kb}}\right)} = \frac{t_m - t_r}{t_w - t_r} = \frac{h_N}{h_M} \quad \text{(19)}$$

By this relationship, h_N was converted to h_M (which approximates h of the theoretical analysis) for each test.

The experimental values of h_M determined from Equation 19 represent several panel surface emissivities and two air flow conditions. In order to show the effect of emissivity and air flow velocity on the heat transfer coefficient, Fig. 8 was constructed by

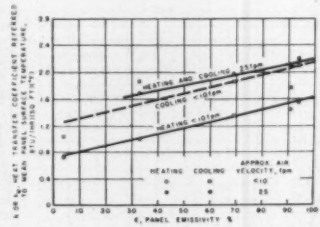

Fig. 8 — Variation of experimental heat transfer coefficient with surface emissivity and air velocity

plotting average values of h_M against emissivity for each of the two air flow conditions. The data points in Fig. 8 represent the average of values of h_M for all tests run at each condition of emissivity and air flow.

The lower of the two solid curves in Fig. 8 represents data from tests made with the perforated air diffuser partition erected along the inlet air wall of the test room. With this arrangement, the air flow velocity was considered to be less than 10 fpm. The upper solid curve in Fig. 8 represents data from tests made with no diffuser partition and with the louvers on the inlet air grilles turned half up and half down. With this arrangement, the average of air velocities was 25 fpm.

The dashed line in Fig. 8 represents the variation of h_M with emissivity, ϵ, for cooling tests involving inlet water temperatures of 60 F and air flow velocities of less than 10 fpm. That the heat transfer coefficient is higher for cooling than heating is explained by the fact that in cooling, the natural convection causes the warm air to continually rise and replace the cooler air next to the cold panel. In the case of heating panels, there is a layer of very warm air against the ceiling panel which tends to remain near the ceiling and this lack of air motion retards the release of heat by convection.

This conclusion is supported by the fact that the coefficients for heating and cooling are nearly identical for the tests at the higher air velocity of 25 fpm, Fig. 8. In this case, there is sufficient forced air movement to cause removal of the layer of warm air at the ceiling, thus increasing the convection heat transfer. Thus, the heat transfer coefficient is nearly identical for heating and cooling when there is appreciable air motion across the panel surface.

A thorough study of the effect of emissivity, air motion, and temperature upon the surface heat transfer coefficient h was beyond the scope of the work reported in this paper. However, the values shown in Fig. 8 are believed to be typical of those to be expected in ceiling panel installations.

The coefficient of heat transfer from the water in the tube to the panel surface under the tube c was also determined from the experimental data. This coefficient was calculated by the equation:

$$c = \frac{(Q/A)(s)}{\Delta t} \quad \text{(20)}$$

The heat transferred per unit area of panel, Q/A, was determined for each test, as previously described. The average temperature difference, Δt, was determined for the whole panel by subtracting the average of six measured under-tube surface temperatures from the average of three measured water temperatures for each test.

Considerable variation occurred among the values calculated for this coefficient. However, Equation 20 shows that for a given heat transfer rate, the value of c varies inversely with the temperature difference. With this type of relationship, for small values of Δt, such as were generally encountered in these tests, a small change in Δt will produce a considerable change in c. In these tests, the measured values of Δt ranged from zero to approximately 10 deg with an average of 2.4 deg for all tests. Thus, small errors in the measurements of Δt could be expected to produce rather wide variations in the values obtained for c. Actual values of c varied from approximately 4 to 120 Btu per (hr) (ft of tube) (F deg) with the average level of c being influenced by flow rate and temperature.

Although there was considerable variation in the experimentally deter-

mined values of c, it can be shown by the analytical equation that, for a large change in c above about 10 Btu per (hr) (ft) (F deg) there is a very small change in the heat transfer rate, h'''. Therefore, the following average values of c, Btu per (hr) (ft) (F deg) were determined for heating and cooling at the indicated water flow rates:

	1 gpm	¼ gpm
Heating	50.0	15.0
Cooling	25.0	7.5

These values of c are believed to be sufficiently accurate for a brazed joint that provides a short, wide heat path of high conductivity. However, with other types of joints that provide a lower overall conductivity, more accurate determinations of c would probably be necessary, since the overall heat transfer rate, h''', becomes quite sensitive to variations in c at low values of c.

Comparison of Experimental and Calculated Performance

Theoretical panel performance Q/A for each of the test conditions in Table 1 was determined through the use of the design chart, Fig. 7, in accordance with the previously described method using values of h selected from Fig. 8 and the values of c reported in the previous section.

For example, the panel used to demonstrate the application of the design chart had been painted with an ivory paint that gave a surface emissivity of 94 percent. With the test room inlet air duct louvers adjusted half up and half down, the average air velocity across the panel surface was 25 fpm. For this emissivity and air velocity condition, the heat transfer coefficient h from Fig. 8, was found to be 2.15, the value used in the design chart example. When the panel was used for heating at a water flow rate of ¼ gpm, the joint heat transfer coefficient c was shown in the previous section to be 15.0. Using these values of h and c, the overall heat transfer coefficient h''' was found from the design chart to be 1.22. Q/A was then determined by multiplying h''' by $(t_{w1}-t_r)$. The average value of t_r for all heating tests was 75 F. Consequently, for inlet water temperatures of 180, 160, and 120 F, the values of $(t_{w1}-t_r)$ were 105, 85, and 45 deg, respectively. Multiplying these values by $h''' = 1.22$ gave values for Q/A of 128, 104, and 55 Btu per (hr) (sq ft). Similar calculations were made for all test conditions and are presented in Table 1 as the lower value in each block.

In general, the agreement between actual test results and calculated performance improved with increasing panel temperature. As might be expected, the greatest differences occurred for the cooling tests. On the whole, 46 percent of the calculated values were within ± 5 percent of the measured values, 75 percent were within ± 10 percent, and 90 percent were within ± 15 percent. In the worst case, the theoretical value was 33 percent greater than the experimental.

The fact that the actual values of the heat transfer coefficient varied considerably from the average values used in the calculations is the primary cause of differences between test and calculated performance. When the actual experimental value of h_M for each test was used to calculate performance, 60 percent of the calculated values were within ±5 percent of the measured values, 93 percent were within ± 10 percent, and the greatest deviation was 16.7 percent. Substitution of actual values of c and $(t_{w1}-t_r)$ in the calculations further improved the agreement.

Conclusion

It can be concluded that reasonably accurate predictions of the thermal performance of a wide variety of aluminum ceiling-type heating and cooling panels (including types in which aluminum panels are fastened to tubes by mechanical means such as clips) can be made through the use of the design chart (Fig. 7) or Equations 11 or 12 and properly selected values of all contributing factors.

Acknowledgment

The authors express their appreciation for assistance in outlining the test program to the architects for the Alcoa Pittsburgh Office Building, Harrison and Abramovitz, and to the consulting engineers, Jaros, Baum and Bolles. Alfred L. Jaros, Jr. was particularly helpful throughout the work. Design and construction of the panels and test room facilities were supervised by Aluminum Company of America staff engineers, E. C. Collins, P. J. McCarthy, J. R. Walgren, E. V. Cross, B. R. Small, H. M. Short, and L. M. Young. Determination of values of thermal conductivity and emissivity were made under the direction of C. S. Taylor, chief, Physical Chemistry Division, Aluminum Research Laboratories.

BRAB ADVISES U.S. ON CONSERVATION

A contract for advisory services by the Building Research Advisory Board on the subject of conservation in building construction has been signed between the Federal Government and the National Academy of Sciences at the request of the Defense Production Administration.

Under this contract, BRAB is to make a study of technical information on existing practices, standards, and regulations which will provide reliable criteria for the evaluation of conservation measures in building design and construction. As the study progresses, BRAB will also investigate proposed and alternative practices which are not in effect generally, but appear to have potentials for conservation.

A second phase of the BRAB study will be to review practices in federal building construction, including military construction. This part of the study will be directed especially toward identifying conservation measures practiced by agencies of the government engaged in construction and to determine differences in the standards of the various agencies.

BRAB expects to enlist technical aid and advice of many people who represent the technical bodies which establish standards for the building industry.

A CHALLENGING FIELD

By I. W. Cotton, *Chairman*, COMMITTEE ON RESEARCH

A member of ASHVE privileged to serve on the Committee on Research soon learns that the Society represents a progressive and courageous vocation.

Many of the projects now facing Society research have resulted from the need to know the basic data underlying successful practices recently developed. Such data must be translated into accurate formulae to guide design and installation engineers in achieving fully satisfactory jobs in the new art.

Our dynamic industry ventures from the well-known into the intriguing unknown, which continually beckons. Ideas are crystallized into application: the job succeeds. Complete prior knowledge of the fundamental scientific data underlying the success seldom precedes the forward step. Research is then called upon to disclose and correlate all pertinent data and to formulate the basic principles to be followed in expanding individual job successes into universally available standard practices.

A procession of new building materials composed of substances with largely unknown characteristics has appeared within the last few years. Accurate information about these products and correct formulae for their usage become urgently required, and Research goes to work to supply the answers.

Study of environmental effects on the human body must accompany developments in our art. We need to know the extent of proven benefits resulting from our advancing practices; if people in impaired physical condition react unfavorably to any situations accepted as genuine improvement by the public generally, we must know that too. Continuous study of human health response to our processes will be a very important function of Society research for a long time.

Many manufacturers of products used in heating, ventilating, and air conditioning maintain active research departments. These invent and develop new products, improve existing items, and increase manufacturing efficiencies. They test equipment for performance and durability. Their work directly affects their own marketing and profit situations.

Increasing numbers of these manufacturing institutions also support Society research, looking to us for underlying basic scientific knowledge, development of comprehensive, accurate formulae and standards under which individual products can classify. They know that their own items will be properly utilized, will be incorporated into correctly engineered installations and will enjoy expanding markets supported by public confidence if the Society provides dependable fundamental data on design and application.

During the past year we have offered our services to various branches of the Government, particularly those concerned with National Defense, and we stand ready to undertake tasks which fall within the scope of our particular aptitudes. Projects now actively concerning our own laboratory at Cleveland and our cooperating institutions exemplify the wide range of present interests.

The current Society research program includes:

Completion of the Environment Laboratory (originally called the Calorimeter Room) and preparation for the studies in panel heating for which it was designed. The floor, ceiling, and 4 sides of this 25 x 12 x 12 ft room are composed of panels which can be regulated independently to any temperature from 20 F to 140 F. Widely varied heating situations can be simulated and accurate determinations of heat flow made and recorded. Definite projects in sight will require the facilities of this room for several years. The room and its equipment will probably stand out as unique for some time.

US Navy Human Calorimeter, being built for the Bureau of Medicine and Surgery through the Office of Naval Research. (ONR Contract). For studies of heat exchange between man and the surrounding surfaces, with surface temperatures ranging from 30 F to 200 F at close tolerances. The contract has another year to run. The design, most of the development work, and much of the construction have been carried out by the Laboratory Staff.

Solar Heat Gain Through Glass; investigations begun six years ago, with design data on unshaded glass already developed and now in THE GUIDE; studies now going forward of different types of sun-shading devices for development of data on shaded glass areas for THE GUIDE.

Study (at College of Medicine, University of Illinois, Chicago) of the physiological adjustments of healthy and physically impaired persons to sudden changes in environment.

Studies (at Kansas State College) on the downblow of heated and cooled air streams.

Studies (at University of Minnesota) on solar energy as a potential heat source of the heat pump.

Sol-air Thermometer studies (At Cornell University).

Studies (at Case Institute of Technology) on air distribution from various types of outlets, particularly ceiling outlets.

Studies (at Pennsylvania State College) on moisture migration through thin sheet materials.

Studies (at Michigan State College) on air flow through take-offs from rectangular ducts.

Air Entrainment in hot water heating systems (Univ. of Fla.).

Ventilation Jets; experimental work (at Laboratory) terminated and data being analyzed.

Odors; odor-free test room authorized and in preparation (at Laboratory).

Studies of Instantaneous Heat Gain and Cooling Loads (at Laboratory).

Other projects, studies and reports are progressing under Technical Advisory Committees on:

Air Cleaning	Industrial Ventilation
Air Distribution	Insulation
Combustion	Odors
Cooling Load	Panel Heating and Cooling
Heat Flow through Glass	Physiological Research
Heat Pump	Sensations of Comfort
Heating Load	Sorbents
Hot Water and Steam Heating	Sound Control
Human Calorimetry	Weather Design Conditions

Members of the Society sometimes express the opinion that Society Research lags behind practice. Research must always reply that this is **exactly as it should be!**

Since Society research does not invent or inaugurate the new practices which become important components of our total art, but concerns itself with supplying accurate, dependable data necessary to insure successful heating, cooling, and ventilating installations, our research simply must follow and not lead the field.

Should Society research ever catch up with actual practice, it could only be because the field has quit trying new ideas. We do not need to fear such a calamity; we can be proud of our dynamic industry and confident that inventiveness and courage will dominate our future.

With this true, new improvements will continue to flow, and Research will continue to study and proclaim. Our ideal should be for Research to try constantly to narrow the gap between itself and the field; but our ambition for a future of expanding accomplishment should make us hope that Research never does completely catch up.

Discussions

Papers Presented at Semi-Annual Meeting

Portland, Ore.

July 2-4, 1951

Optimum Panel Surface Distribution Determined from Human Shape Factors*

by F. W. Hutchinson and Merl Baker

R. C. VANDERWEIL, Boston, Mass. (WRITTEN): Human shape factors with respect to floor areas, together with those in respect to wall and ceiling areas, will supply the designing engineer with the data required for the solution of a number of special heating and cooling problems. They will help in the design of cooling systems for spaces such as rooms containing great numbers of business machines or other heat generating equipment. Even more important, they will enable the engineer to design the most economical heating systems for large industrial plants where aisle locations are fixed for present as well as for future operation. It is conceivable that by the use of properly located floor panels in such buildings, large fuel savings may be obtained.

With reference to the application of the human shape factor to the design of conventional room heating systems, I should like to express appreciation of the author's remarks on the great majority of heated rooms. It appears that in the 10 by 10 ft room a shallow circumferential coil presents an ideal solution of the heating problem — if none of the walls are outside walls and the ceiling or roof loss is fairly constant through all points of the ceiling.

However, as the authors point out, when one of the walls of this room is an outside wall, and therefore has a considerably lower surface temperature than other room surfaces, it will be necessary to concentrate the heat output of the floor or ceiling panel in the area adjacent to this wall.

We should remember that maximum comfort in a room, in regard to heat interchange by radiation, will be maintained if the difference between heat loss and heat gain per square inch of human body — front, back or side — remains constant no matter where the occupant may be located within the room.

I should not necessarily desire to occupy steadily a room designed according to such principles for fear that I might grow stale and miss the refreshing effect of a few cold spots. However, extreme variations of the heat balance of a human body within a room should be avoided. The heating designer became aware of these principles many years ago when he removed the radiator from the inside wall and replaced it by radiation under the window.

A complete analysis of radiation conditions within a room would have to consider radiation influx from the heated panel superimposed over the radiation loss of the human body to the cold outside wall and glass.

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Barometric Draft-Control Analysis*

By H. B. Nottage, D. W. Locklin, and R. G. Huebscher

HUGH KELLY†, Milwaukee, Wis. (WRITTEN): This paper shows every evidence of careful and painstaking analysis and is of great interest to us as far as the points covered are concerned. The following comments are offered only in the most cooperative spirit:

1. It would have been helpful to have had actual diagrams of the physical test set-up included in the paper.

2. It is stated that coefficients of bleed flow and torque force are dimensionless but it would seem from their use in equations that they have some physical interpretation which could be more clearly brought out.

3. A fuller discussion of the effect of variations in the various coefficients with relation to damper performance would have been very helpful.

4. One phase of the study which is of great importance, but which has not been included in this paper, is the relationship of controlled draft to available draft under conditions of varying resistance such as are encountered in actual installations.

It is unfortunate that the complete program as outlined by the Technical Advisory Committee cannot be completed at this time, as the information so carefully compiled in this paper loses much of its practical value through lack of supporting data which would have been available if the other steps outlined in the program had been taken.

If the limited scope of this investigation had been foreseen, it probably would have been of greater value to the members of the Society as a whole to have concentrated on items four and five of the program so that the best possible use could be made of the controls now on the market.

I believe that this program should be carried through to completion at the earliest possible date with the ultimate end in view of setting standards as outlined in item six of the program.

I would like to congratulate the authors, who so ably prepared this paper, and to express the hope that they can continue the project.

R. K. THULMAN, Washington, D.C. (WRITTEN): The work which the authors have concluded in connection with the investigations of barometric dampers is most significant in emphasizing the insufficiency of existing knowledge of the behavior of draft systems. The importance of more complete data on draft systems is apparently not fully realized by the profession or by the industry. This is especially the case with those of us who are directly concerned with residential heating.

In the operation of every household fuel-burning device, the draft system requires far more serious consideration than it has received to date. The barometric damper, in its several forms, has been used primarily as a device to limit draft — to keep draft from getting too high. Such use assumes that the draft produced by the flue is more than enough to assure the proper operation of the fuel-burning appliance. For this reason, the operation of draft control devices leaves much to be desired during the critical heating period which follows the initial start of an automatically controlled appliance. The need for a barometric damper which will remain closed, and tightly closed, until the desired limit is reached, is apparent. It is equally apparent that the design concept

†Chief Engineer, Controls Div., Perfex Corp.

of barometric dampers commonly used might be critically examined. Such a critical examination can be profitable to the profession and industry if the work described in the authors' paper is intelligently applied.

I have observed with great misgiving the installing contractor's tendency to omit draft regulators from residential heating installations. This omission occurs frequently in installations in houses where the chimneys are low and the available drafts are of the order of one or two hundredths of an inch. An impressive proportion of houses of this type are of limited volume and of tight construction. Few people have realized that an assured supply of air to the fuel-burning appliance is just as important as provision for the disposal of combustion products through a flue. It is an essential part of what the authors term the *draft system*.

The most alarming statement in the paper is that *further work is not presently contemplated*. Back of this statement, and equally alarming to me, is the difficulty which the Technical Advisory Committee on Combustion has encountered in getting anything done at all.

It will be tragic indeed if the work done so far is ended because of lack of appreciation of its importance to house heating. The need for a comprehensive study of the entire draft system is certainly far more important than most of the research projects now enjoying the blessings of the Committee on Research. In the Director's letter transmitting a copy of the paper to me for comment, I was invited to suggest whether any further work should be done in this field by the Society. It seems to me that a *suggestion* to this effect is the mildest comment that could be made. Further work, expedited by an enlightened appreciation on the part of the Committee on Research, is necessary and essential if the Society's contribution to the public is to be advanced.

Let's get busy on those things with which the public, the industry, and the profession are more directly and more widely concerned even though it means the postponement of investigation of heat emission from an infrequently used ceiling panel made of an unobtainable metal which the builder cannot afford to use if he can get it.

The Control of Air Streams from a Long Slot†

By Alfred Koestel and Chia-Yung Young

G. B. PRIESTER, Baltimore, Md. (WRITTEN): The authors are to be complimented on their presentation of the theory, correlating test data, and application information on air streams from a long slot.

As was previously pointed out, however, I do not believe that the friction loss in the tapering duct should be completely ignored even though it may be a small item. The friction drop for 1500 cfm at 2000 fpm, as used in the example, is practically ½ in. of water per 100 ft. of duct.

Since the desired throw usually is fixed in practice, it would be helpful if a practical example could be presented for a condition of 30 ft. throw. It is also suggested that an example using a lower duct velocity, say 100 or 1500 fpm, be included.

Two-Year Performance of a Heat Pump System Furnishing Year-Round Air Conditioning in Modern Office Building††

By Philip Sporn and E. R. Ambrose

F. R. ELLENBERGER, Bloomfield, N.J. (WRITTEN): The authors of this paper are to be commended for showing that a large building heat pump system can be practicable, dependable and economical when properly engineered and installed. The authors' company has been a pioneer in this field. Other organizations would do well to emulate its vision and foresight.

Mention could be made of the fact that, although the authors' company was responsible for the overall design of the described system, various manufacturers cooperated in the installation, including the discusser's company which furnished many of the basic elements of the system, compressors, heat transfer coils and the year-around remote room-air conditioner units.

Of particular interest is the *heat factor* proposed in this paper as a constant for comparing operating cost of systems in different geographical areas. A brief analysis will show that this factor is not actually a constant but varies with the design temperature and the temperature of the heat source — in addition to being affected by variations in wind, sun, and lights, as was pointed out in conclusion No. 5. It can be shown that the heat factor proposed is actually equivalent to 2.08/P.F. for a design temperature of 15 F, where P.F. is the *performance factor* or coefficient of performance integrated over a particular period.

The discusser recently proposed a similar heat factor* expressed in the form:

$$\text{H.F.} = \text{Heating kwhr}/[(\text{Degree-days}/1000)(\text{Hourly Btu/F deg})]$$

This form has the advantage of being independent of the heating design temperature and is numerically equal to 7.03/P.F. If the variation of coefficient of performance is essentially linear with outdoor air temperature, as it generally is for an air-source heat pump, then the P.F. can be predicted by taking it as equal to the COP at the average outdoor temperature that exists during the time heating is required in any locality. This temperature can be found from weather records and the relationship:

$$\text{Equiv. heating temp} = 65 - (\text{Degree-days}/\text{No. of days with mean temp less than 65 F})$$

As shown on the included figure in a paper*, a surprisingly good heat factor correlation has been found to exist in most areas of the United States between this temperature and the normal degree-days. Most localities, except those noted as separate points, fall very close to the line.

This heat factor has been used to check a number of instrumented field test installations of packaged heat pumps in diverse geographical locations and, based upon measured power consumption and measured heat output, has been found to show very good correlation with that predicted by the proposed method.

It is hoped that the industry will give further study to the use of a heat factor similar to that in the present paper, or that suggested in these comments, in an effort to provide a more useful tool for estimating and comparing operating costs of heat pump installations that might also be more convenient to use than coefficients of performance and performance factors.

It is apparent that the calculated heat loss for the described installation was considerably in excess of the actual heat loss, since the average heat factor of 0.686 is equivalent to a performance factor of 4.5, whereas the COP for one-compressor operation at 55 F was found to be 4.28, and for two-compressor operation at 33 F, 3.53. I would be interested in the authors' comments on the desirability of omitting the power inputs to circulating pumps and conditioner fans in arriving at the values given, rather than the corresponding figures of 2.82 and 2.73 when they are taken into account. Also I should like to know what means were taken to insure that 100 percent of the electric energy to compressor motors be recovered as useful heat.

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††Published in ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, August 1951.

*Year-Round Air Conditioning with the Heat Pump (*G.E. Review*, Dec. 1950)

AUTHORS' CLOSURE: I am very glad to have Mr. Ellenberger's remarks on the importance of a heat factor in evaluating heat pump performance and I, too, sincerely hope that more effort will be made in this direction in the future. The close correlation of the heat factor obtained by Mr. Ellenberger on the experimental installations may be partly due to the fact that they were residences void of high internal heat gain. In commercial installations, the lighting load and other internal heat gain will materially affect the correlation.

In comparing costs of heat pumps with the more conventional year-round air conditioning systems, it is more convenient to exclude the distribution system, since it is usually the same for both types of systems. In such comparisons, the coefficients of performance given in Tables 2 and 3 generally are used. To obtain the total operating costs of the complete system, however, all energy consuming equipment should be included.

No particular means were employed to insure that all motor losses would be useful heat. The equipment is located in the penthouse and the heat dissipated is used to maintain comfortable temperature levels in this area.

In regard to Mr. Chewning's questions, the two 5000 gal water tanks are used for the storage of hot or cold water during mild weather for use when extreme temperatures are being experienced. There are four or five such installations on the American Gas and Electric System and we find that they proved to be practical. The one possible disadvantage is the space required by the tank.

In reply to Mr. Smith's question, I would say that no trouble has been experienced with defrosting of the outdoor coils. An automatic defrosting cycle is used as described in the reference article which is made a part of this paper as follows:

The outdoor coils are defrosted automatically during the heating cycle. If the outdoor air-refrigerant suction temperature differential exceeds a predetermined value, indicating accumulation of frost on the coils, the position of the four-way valve is changed so that the high temperature, high pressure refrigerant gas from the compressor goes first to the outdoor coil where it is condensed, giving up its latent heat to defrost the coils. The path of the refrigerant during the defrosting cycle is the same as that for the cooling cycle. The circulating water can continue to furnish heat to the conditioned space during the cycle by using water from the storage tanks.

In reference to Mr. Kroeker's question, we have found that simultaneous heating and cooling of a building is readily adaptable to this heat pump cycle, as it is to any other heat pump cycle. In fact, one of the advantages of a heat pump system is the ease with which such requirements can be incorporated in the building design.

The auditorium coil is shown in the flow diagram in Fig. 1. This coil enables cooling to be supplied to the auditorium at the same time that heating is supplied to the remainder of the building. The auditorium is used quite frequently by large groups of people so that cooling is necessary many times during the winter months.

Climatology as an Aid in Heat Pump Design*

By G. S. Smith

L. R. INGERSOLL, Madison, Wis. (WRITTEN): I want to compliment Professor Smith on his heat pump investigations, partly because of the use he has made of heat conduction theory in connection with his experimental work. It is true that theory is sometimes far from satisfactory here, due to unknown or complicating factors, such as moisture migration in the soil, but in any case it can help to guide investigation. Without it, experimentation may degenerate into merely *shooting in the dark*.

It might be pointed out that a series of underground temperature measurements, such as was made, affords one of the best possible means of measuring the thermal diffusivity of the soil, and, indirectly, its thermal conductivity. This presupposes that great care is taken — as I assume was done here — in arranging the thermocouples so that conduction along the wires cannot vitiate their readings.

I am interested in the calculation of the total seasonal heat taken in by the ground because of some computations I have made for a different purpose. I would warn against overestimating the importance of such calculations, however, because they apply with any exactness only to the hypothetical case of a continuous grid under a large ground surface area. In the usual practical case of more or less isolated pipes a large share of the heat is drawn laterally. Professor Smith takes account of this fact, but does not stress it as much as I would be inclined to do.

E. B. PENROD†, Lexington, Ky. (WRITTEN): The approximate method, outlined by Professor Smith of using Weather Bureau records to determine information needed to design earth heat pump systems is very timely. The proposed method should be utilized by heat pump engineers in designing pilot heat pumps in localities where the necessary data are available. If this is done, operating data should be taken over a number of years to check the method. At the present time there may be sufficient air temperature data in the various weather stations, but few surface temperature data have been taken and recorded. Where surface temperature data are not available, the proposed method is not applicable.

The paper will be exceedingly valuable if it stimulates meteorologists and climatologists to extend their investigations to the measurement of soil temperatures at various depths and the vertical component of solar radiation. Wherever soil temperatures are measured, the soil should be analyzed to determine the Casagrande classification, moisture content, liquid limit, plastic limit, and the plasticity index.

The author states that air temperatures were recorded from near the earth up to a height of 150 feet at 12 min intervals, but failed to mention whether the average air temperatures shown in Fig. 4 included readings at more than one elevation.

In discussing the optimum depth for a ground coil, the author did not consider the performance obtained when the heat pump was operated on the cooling cycle. In many localities, the earth heat pump will operate as long on the cooling cycle as it does on the heating cycle. It should be recognized that a considerable amount of heat can be stored in the soil during the cooling season if the earth heat exchanger is placed at the proper depth.

It is interesting to note, in the example cited, that the heat absorbed by soil due to rainfall was approximately 10 percent of that from solar radiation. From Fig. 9, however, for a base temperature of 48 F, it would appear that the heat from the sun should be about 6400 Btu per (sq ft) (season) instead of 7450. If so, a value of 6930 would be obtained. This, in turn, would give a column of about 30 instead of 35 ft.

Since the expression *Moisture 10 percent = 0.018 k = 0.544 = 93 dry* is obviously not an equation, an explanation by the author should follow so the reader can use the data.

In conclusion, I would like to point out that the proposed approximate method can be understood and applied by a competent design engineer. A casual study of the paper shows that a tremendous amount of work was done in collecting the data presented. Heat pump engineers are very fortunate in having the results of this investigation made available.

T. H. URDAHL, Washington, D.C. (WRITTEN): This paper is timely in that it adds much needed emphasis to the value of a United States Weather Atlas. Such a volume is about to be prepared by the *United States Weather Bureau*, with the assistance of interested groups, if funds

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†Head, Dept. of Mechanical Engineering, University of Kentucky.

are made available by the Congress of the United States.

Data upon which to base such an Atlas, including those which would show the feasibility of heat pump operation in a given locality, are available in present records, but never have been presented in a form readily usable by designers. The processing of the data, and their presentation approximately in the form indicated by the author, would do much to give the heat pump wider practical application.

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS has been foremost among engineering groups advocating the compilation and publication of a Climatic Atlas and showing the immense economic benefits to be realized through a more complete knowledge of climatic conditions, quantitatively expressed for the country as a whole and for localities individually.

The work of the Society, under its Technical Advisory Committee on Weather Design Conditions, has stimulated the interest of other groups, and the Weather Atlas has been endorsed as a primary need of the construction industry by the *Building Research Advisory Board* of the *National Research Council*, the *American Institute of Architects*, the *Air Conditioning and Refrigerating Machinery Association*, and many other trade and professional groups.

Heat Requirements of Buildings*

By C. W. Signor

D. W. LOUCKS, Pittsburgh, Pa. (WRITTEN): This paper contains much information of interest and value to those concerned with the operation and maintenance of buildings.

In the first place, Table 1 shows a method of keeping a record of steam consumption. Many, if not all, district heating companies keep a steam consumption record in some form for most of their steam users, in order to assist the users in obtaining economical operation. This affords a means of watching the performance of the heating system and the care with which it is being operated. Everyone interested in economical operation can profit by establishing some system of recording and observing the rate of steam use.

This paper also shows the value of efforts to reduce steam consumption as indicated in Table 2. By averaging the consumption for each five-year period we find the steam used in pounds per square foot of radiator surface per degree below 65 F to be as follows:

1921-25	— 18.8
1926-30	— 16.5
1931-35	— 12.4
1936-40	— 12.5
1941-45	— 13.04
1946-49	— 13.8

It will be noted that the rate of steam use was highest during the period 1921-25, being 18.8 lb per sq ft, lowest during the five-year period 1931-35, and then steadily higher from this period. This is an interesting trend because it indicates that about 10 years of concentrated effort on the part of the district heating company was required to reach the maximum effect of such efforts on a large group of steam users. The gradual increase after that period up through 1949 is undoubtedly caused by improved business conditions. These may cause an increased rate of consumption in two ways: first, the occupancy and the activity of any given building increases; second, as business improves there is less tendency to scrutinize such costs as heating as carefully as might be the case under poor business conditions.

The information given in Table 3 indicates certain unit measures of steam usage for various classes of properties. It should be pointed out that these measures are more relative than absolute. In other words, these rates of steam use should be used more for comparison than for estimating steam consumption for various buildings.

The rate of steam use in pounds per cubic foot per year is not an accurate method of estimating steam usage because of the influence which the shape of the building may have on the ratio of volume to exposed wall area. It is therefore not a highly precise method of comparing the steam consumption of one building with another. For example, one building having dimensions of 25 by 100 ft has the same volume as another building having dimensions of 50 by 50 ft, provided they have the same height. In one case the perimeter of the building is 250 ft and in the other case the perimeter is 200 ft. It would, therefore, be expected that the rectangular building would have a greater steam use per unit of volume than would the square building.

While the unit steam consumption per square foot of installed radiator surface may be more precise, it also is subject to error because the amount of actual radiation installed may not conform to the actual or calculated heat loss. This condition is frequently encountered in buildings of the older type.

These methods of measuring the rate of steam usage are, however, most valuable in watching the year to year performance of a given building and are also valuable if used properly as a guide to the relative efficiency with which buildings of the same class are using steam.

*Published in ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, June 1951.

TWO MEMBERS' PAPERS IN LONDON CONFERENCE

Papers by two members of the Society are scheduled for presentation at a general heat transfer conference in London, September 11 through 13.

The members are Carl F. Kayan, professor, Department of Mechanical Engineering, Columbia University, New York, N.Y., and F. C. Hooper, lecturer, Department of Mechanical Engineering, University of Toronto, Toronto, Ont., Canada. Professor Kayan's paper is *Heat Exchanger Analysis by Mechanical Analogy Studies*. Mr. Hooper is junior author of the paper, *The Possibilities of the Heat Pump in Canada*, and E. A. Allcut, also of the Department of Mechanical Engineering, University of Toronto, is senior author.

The conference, using developments in heat transfer and in the design of related apparatus as the subjects for discussion, was arranged by *The Institution of Mechanical Engineers* and *The American Society of Mechanical Engineers*. ASHVE was among eleven North American societies cooperating with *ASME* in presenting the program. Thirty societies from Britain, the British Commonwealth, and Europe cooperated with *The Institution of Mechanical Engineers*, *The Institution of Heating and Ventilating Engineers* being among them.

The two organizing institutions handled arrangements for the presentation of groups of papers, and it was anticipated that they would submit 40 to 50 each, making some 80 to 100 papers available for discussion. Papers were restricted to developments which have taken place in the past ten years and five main group headings were agreed upon as covering the field of discussion. They are: heat transfer with change of state; heat transfer between fluids and surfaces; conduction in solids and fluids; convections, radiations, instrumentation, measurement techniques, and analogies; and special problems.

L. P. Saunders, Lockport, N. Y., was appointed official ASHVE delegate to the conference.

J. L. COLEMAN, JR., HEADS SAUER, INC.

J. L. Coleman, Jr., a member of the Society, was elected president of Sauer, Inc., mechanical contractors concern, Pittsburgh, Pa., at a recent meeting of the firm's board of directors.

Mr. Coleman, who has served as vice president and secretary since 1934, succeeds the late William N. Steitz. Mr. Coleman is a registered professional engineer and also holds memberships in the *National Society of Professional Engineers*, its Pennsylvania association, and in the *Heating, Piping and Air Conditioning Contractors National Association* and its local Pittsburgh group.

REMA ANNOUNCES EXPOSITION DATES

Over 200 manufacturers of refrigeration and air conditioning equipment will display their latest equipment at the 7th All-Industry Refrigeration and Air Conditioning Exposition at the Navy Pier, Chicago, Ill., from November 5 to 8. The exposition is sponsored by the *Refrigeration Equipment Manufacturers Association of Washington, D.C.*, and is a national trade show with free admission, by registration, to anyone identified in any way with the refrigeration or air conditioning industry.

JOHN JAMES ELECTED VICE PRESIDENT OF McDONNELL & MILLER

John W. James, a member of the ASHVE Council and former Technical Secretary of the Society, has been elected vice president in charge of research for McDonnell & Miller, Inc., Chicago, Ill., according to a recent announcement.

John James, Chicago, Ill.

Born in Brookville, Ind., January 12, 1907, Mr. James was graduated from Oregon State College in 1928 with a B.S. degree in mechanical engineering. He began his business career that same year with G. E. Reed, Portland consulting engineer, in whose office he served until 1932, when he was awarded a research fellowship to study in the Mechanical Engineering Department at the University of Wisconsin. In 1934, he was awarded a master of science degree at Wisconsin and then came east to join the General Electric Co., Schenectady, N. Y.

Mr. James joined Society headquarters the following year as technical assistant and later was named Technical Secretary. During his several years of service with the Society, his responsibilities included preparation of THE GUIDE, the correlation and administration of the cooperative research program of the Society, and work with technical and code committees. In 1943, he was appointed development engineer for Iron Firemen Mfg. Co., where he remained until 1948 when he left to join McDonnell & Miller as chief research engineer, the position he held at the time of his recent election as vice president.

Society positions in which he has served include: Committee on Reseach, 1944-45 and '47-'49, serving as its vice-chairman in 1949; chairman, Publication Committee, 1947-48; chairman, Group B, TAC on Panel Heating and Cooling, 1947-50 and member in 1951; Program and Papers Committee, 1950; chairman, TAC on Hot Water and Steam Heating, 1951; Finance Committee, 1950-51 and chairman of its Ways and Means Committee, 1951. He also has served as a member of the Society's Constitution and By-Laws, Nominating, Publication Policy and Guide Publication Committees. He was elected to Council in 1950.

ST. LOUIS

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Summary of Chapter Meetings*

• *GOLDEN GATE*—June 7, 1951. The meeting was called to order by Pres. R. C. Cushing and the minutes of the previous meeting were read and approved. Following President Cushing's appointment of James McLachlan, E. C. Sanford, and F. W. Berger, Jr., as a Tellers Committee, reports were given by Treasurer J. E. Murray, Membership Chairman E. F. Dill, Attendance Chairman Eric Roberts, Finance Chairman H. R. Scandrett, and Publicity Chairman D. E. McLeod. Program Chairman T. J. Janes then introduced the guest speaker, Walter Davis, N.P.A., who discussed building limitations and material shortages and outlined the new controlled materials plans. Attendance 59.

• *KANSAS*—June 11, 1951. A special meeting was called by Pres. R. F. Bauer in the Rainbow Room of the Coleman Co., Inc. Following reading and approval of the minutes of the previous regular meeting, President Bauer and Secretary E. G. Fahnestock reported on the Second Preliminary Draft of the Chapter and Branch Handbook and it was voted to instruct the secretary to give the approval of the Kansas Chapter.

H. L. Stevens, chairman of the By-Laws and Charter Committee, read the By-Laws and Operational Guide, which he had prepared for the Chapter. After all paragraphs had been thoroughly discussed and approved, it was moved and seconded that the By-Laws and Operational Guide be adopted for submission to the Society.

• *NORTH CAROLINA*—June 22, 1951. The annual summer meeting of the Chapter was in the form of a social weekend at the Graystone Inn, Roaring Gap, North Carolina, June 22 through June 24. Golf, swimming, horseback riding, cards, dancing, or just plain relaxing were all available and were well participated in by the membership and guests.

The big day on the calendar was June 23, which featured a golf tournament, a social hour, and the traditional banquet. Good food, an entertainment program presided over by W. H. Sullivan, and dancing to a smooth orchestra combined to make the banquet an outstanding success. After a buffet lunch on Sunday, June 24, the 79 members and guests departed, fully convinced that Program Chairman J. W. Barr had done an excellent job in arranging the weekend.

• *PHILADELPHIA*—June 13, 1951. The annual golf tournament at the Cedarbrook Country Club, Philadelphia, was the highlight of the Chapter's regular monthly meeting. The only Chapter business conducted in a short meeting following the tournament saw Past President F. H. Buzzard present retiring President J. W. McElgin with a bronze plaque as a token of the Chapter's appreciation for the fine job he had done during the past year. At the completion of this ceremony, Mr. McElgin introduced new President E. K. Wagner and the other officers and board of governors members who were elected at the April gathering. The meeting was then turned over to the golf committee chairmen, Messrs. C. J. Lubking and R. J. Sigel, who distributed the various golf awards.

• *SOUTHWEST TEXAS*—May 22, 1951. An address by P. N. Vinther on the subject of air conditioning installations that he has designed for the University of Texas was the feature of the Chapter's regular monthly meeting in the Plaza Hotel, San Antonio.

Mr. Vinther, who is a member of ASHVE and a partner in the firm, Zumwalt & Vinther, consulting engineers, Dallas, pointed out that the Health Center and Science Buildings at the University were completed before the advisability of air conditioning had been decided upon. Before any more air conditioning was done, the decision was made to build a central chill water system in a separate structure, with the water to be distributed to the various buildings. The savings in maintenance and repairs was one of the chief determining factors, he said.

Existing tunnels which had been built for steam lines were used largely for routing these cold water lines, he continued. Due to the surplus steam available in summer, steam turbines were used for prime movers. The cooling tower was built as a masonry enclosure, with louvers of hollow clay tile, to improve appearance. Condenser lines were of 22 in. pipe, providing some idea of the size of the job.

Mr. Vinther concluded by describing the different types of control and air distribution systems, revealing that virtually every well known type was employed — conventional low pressure duct systems, double duct systems, and conduit systems.

The address was extremely well received, according to Chapter Secretary D. E. Locher. Pres. I. W. Wilke presided. Attendance 39.

NEW DUTCH LINER AIR CONDITIONED

The Holland-America Line's S.S. Ryndam, recently in New York after ending its maiden voyage from Rotterdam, is the first ship of foreign construction to be fully air conditioned since the close of World War II. The Ryndam, likewise, is the first vessel devoted almost exclusively to tourist accommodations to offer air conditioning for the comfort and health of its passengers. The ship carries 854 tourist passengers and 39 first class passengers.

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

Candidates for Membership

The Society's By-Laws require that all applications for membership or advancement are to be sent to the Executive Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society, or mailed to all members. When the replies are received from references the Candidate's application shall be submitted to and acted upon by the Admission and Advancement Committee as soon as possible.

When the Admission and Advancement Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall confirm the election of the proposed Candidate for membership. During the past month there have been 60 applications for membership, including 1 student application and 1 reinstatement; in addition 4 advancements have been received. The names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Admission and Advancement Committee, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Executive Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by September 28, 1951 these candidates will be voted upon by the Council. Those elected to membership will be notified by the Executive Secretary immediately after election.

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REINSTATEMENT

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OBITUARY

AUGUST H. SCHROTH
San Gabriel, Calif.

August H. Schroth, a Life Member of the Society and former vice president of the Richmond Radiator Co., died in San Gabriel, Calif., April 30, 1951. He was 76 and living in retirement at the time of his death.

Born in Chicago on January 16, 1875, Mr. Schroth was educated in Illinois schools and began his business career in 1892 with the Chicago branch of Pierce, Butler, Pierce Manufacturing Co. Other firms with which he was connected during his lifetime included the Columbia Radiator Co., as New York manager; the Lavashower Co. as president; the Cameron, Schroth Cameron Co., as vice president; the Kellog, McQuay, Cameron Co., as assistant secretary and western sales manager; the Ideal Furnace Co.; and the American Boiler Co. He was vice president, sales manager and a director of the Richmond Radiator Co. for more than 13 years.

Mr. Schroth joined the Society in 1910 and was elected to Life Membership in 1943. He was a member of the New York Chapter and previously had been connected with the Illinois group. For many years he was a member of the executive committee of the National Boiler and Radiator Institute.

The Officers and Council extend their sincere sympathy to his wife, Mrs. June Mason Schroth.

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● **WESTERN NEW YORK:** Organized 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. PRESIDENT, T. F. Killeen, 374 Delaware Ave., Buffalo 2. SECRETARY, R. E. Lang, 140 Meadow Lane, Kenmore 23.

● **WISCONSIN:** Organized 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. PRESIDENT, H. F. Brinen, 226 Kenzie Ave., Racine. SECRETARY, L. C. Plaehn, 914 N. Broadway, Milwaukee.

Student Branches

● **COLLEGE OF CITY OF NEW YORK:** Organized 1949. Headquarters, New York, N. Y. PRESIDENT, Seymour Weinberg, 2147 72nd Street, Brooklyn 4. SECRETARY, Benjamin Karp, 524 Berriman St., Brooklyn 8.

● **LOUISIANA POLYTECHNIC INSTITUTE:** Organized 1949. Headquarters, Ruston, La. PRESIDENT, W. G. McMullen, Box 472, Tech Station, Ruston. SECRETARY, R. L. Gorton, Box 184, Tech Station, Ruston.

● **NORTH CAROLINA STATE COLLEGE:** Organized 1948. Headquarters, Raleigh, N. C. PRESIDENT, Sydney Narvey, 5-B Vetville, State College Station, Raleigh. SECRETARY, E. A. Travis, Jr., P.O. Box 3333, Bagwell Dormitory, Raleigh.

● **OKLAHOMA A. & M. COLLEGE:** Organized 1950. Headquarters, Stillwater, Okla. PRESIDENT, O. A. Brynie, 507 Midi, Vet Village, Stillwater. SECRETARY, D. W. Ray, E126 Bennett Hall, Stillwater.

● **OREGON STATE COLLEGE:** Organized 1949. Headquarters, Corvallis, Ore. Meets, First Wednesday after First Tuesday. PRESIDENT, R. J. Kemper, Jr., 645 N. 4th, Corvallis. SECRETARY, J. M. Templer, 720 Kings Rd., Corvallis.

● **PURDUE UNIVERSITY:** Organized 1948. Headquarters, W. Lafayette, Ind. CHAIRMAN, N. J. Kirch, 922 Highland Ave., Lafayette. SECRETARY, T. L. Burcham, 133 Salisbury St., W. Lafayette.

● **TEXAS A. & M. COLLEGE:** Organized 1946. Headquarters, College Station, Tex. Meets, Second and Fourth Tuesday. PRESIDENT, J. O. Kadel, Box 40544, College Station, Tex. SECRETARY, W. C. Haggard, Box 5227, College Station.

● **UNIVERSITY OF DETROIT:** Organized 1949. Headquarters, Detroit, Mich. Meets, First Tuesday. PRESIDENT, G. H. Williams, 18251 Washburn, Detroit 21. SECRETARY, R. H. Drake, 5598 Hurlbut, Detroit 13.

● **UNIVERSITY OF KANSAS:** Organized 1949. Headquarters, Lawrence, Kans. Address mail to Dr. Warren E. Snyder, chairman, Dept. of Mechanical Engineering, University of Kansas.

● **UNIVERSITY OF TEXAS:** Organized 1949. Headquarters, Austin, Tex. Meets, First and Third Tuesday. PRESIDENT, W. A. Cox, 360-D Deep Eddy Apts., Austin. SECRETARY, V. H. Miles, PHP Dorm J, Austin.

● **UNIVERSITY OF TORONTO:** Organized 1951. Headquarters, Toronto, Ont. CHAIRMAN, H. F. Spragg, 35 Harrison Ave., Aurora, Ont. SECRETARY, J. E. G. Blaiklock, 23 Isabella St., Toronto 5, Ont.

Heating Cost Held Low

IN THIS APARTMENT DEVELOPMENT

■ Norwood Garden Apartments, Baltimore, Maryland, comprises 64 attractive units. They are heated by 18 Fitzgibbons steel boilers, sharing with thousands of similar buildings the ultimate in fuel savings resulting from the combustion efficiency, extremely rapid water circulation, and speedy heat transfer which have made Fitzgibbons steel boilers a favored selection among men who know heating. Get all the facts.

At top, a section of Norwood Garden Apartments, Baltimore, Md. Above, a "D" Type Boiler, one of 18 Fitzgibbons boilers of several types which heat the development. Heating contractors, Sutch and Steigler, Baltimore.

Write for Bulletin HP-9.

Men who know boilers select... FITZGIBBONS

65th Anniversary

MOST ECONOMICAL IN FUEL — THE FITZGIBBONS BOILER — 1886

1886-1951

Fitzgibbons Boiler Company, Inc.

General Offices: 101 PARK AVENUE, NEW YORK 17, N. Y.

Manufactured at OSWEGO, N. Y. • Branches in Principal Cities

Steel saved civilization at Vienna

MODERN history begins with the record of conflict between Christians and Moslems--six centuries of wars that opened with the Crusades and saw the Turks capture Constantinople in 1453.

More than 100,000 Turkish janizaries and cavalry besieged Vienna in 1683. For two months, to quote the diary of an eye witness, "The enemy continued playing their cannon and granadoes. But the city walls were strong, Christian cannon were bigger and more numerous and ammunition more plentiful." Finally came a day when the officer's journal reported, "The enemy did not play their cannon so fast. It was confirmed that they had no great provision of bullets, inasmuch as they shot back not only our bullets, but also pummels of swords and all sorts of iron and stones."

At last a great Christian relief army was assembled. "They made an attack in the best order that ever army did. The enemy, forced always to give back, were put all into confusion. They betook themselves to flight, leaving all their provisions, ammunition, cannons and tents --the greatest part rendered unfit for farther use by our great guns."

Never again did the Turks seriously menace Christendom. Western civilization had been saved once more by its supremacy in the use of iron and steel. To aid our survival America's free private industry is producing steel at the highest rate ever known--and still expanding. The question remains--Will America use enough of this tremendous steel production to guarantee the continued supremacy of Western, Christian civilization?---We believe the answer is yes!

YOUR SCRAP IS NEEDED — YOUNGSTOWN

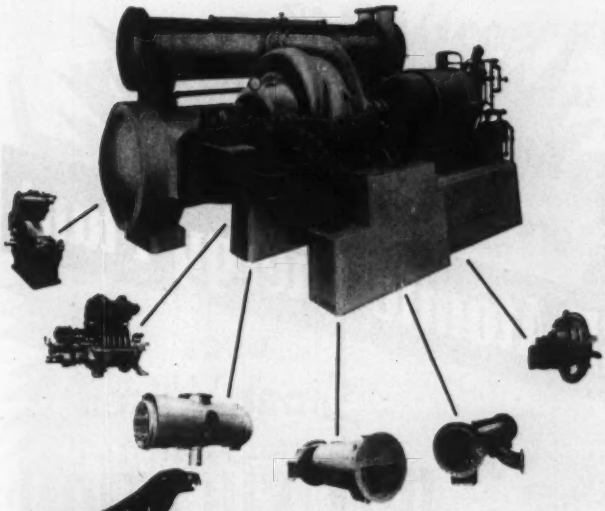
The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio

Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment.



Where do you get

UNDIVIDED RESPONSIBILITY

in an installation of centrifugal refrigeration?

Worthington will "wrap up a package".

Unlike other manufacturers of air conditioning and refrigeration equipment, Worthington *makes*—not just assembles—all the major components for each installation.

Compressor, condenser, cooler and such drive equipment as steam turbines, steam condensers, motors, and step-up gears—are all made in Worthington's own plant—each carefully designed for balanced operation with its companion components.

So the builder and owner can place full responsibility on the one supplier —Worthington.

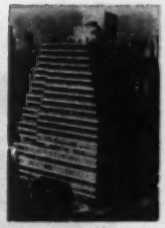
Worthington centrifugal systems are used with most refrigerants and for any process—chilling water, brine, chemicals, lubricating oils—for temperatures as low as minus 160 F, capacities from 150 to 2600 tons.

A typical Worthington compressor feature is the arrangement of the volute passages and impellers to counterbalance the radial and axial thrusts, respectively, in the various stages.

Write for Bulletin C-1100-B14 on Worthington centrifugal refrigeration.

Worthington room conditioners for both heating and cooling are built to operate with chilled water or direct expansion cooling, capacities from 350 to 600 cfm for under-window installation.

PACKAGE UNITS SELECTED TO COOL HUGE OFFICE BUILDING



This is an excellent example of how Worthington's complete line makes it possible to select exactly right equipment.

The new office building at 488 Madison Avenue, New York—home of many famous magazines and large industrial firms—is air conditioned primarily by package units, assisted by a Freon-12 reciprocating system with chilled water and steam coils.

Purpose of using package units in a big building like this is to provide for a variety of conditions imposed by both the building and the type of tenants: air conditioning needed only on top floors during certain seasons, difference in sun load on various sections, certain tenants working late hours but only with skeleton forces.

Second through 20th floors are handled by 38 Worthington 20 and 25 ton Package Air Conditioners, two per floor. Basement, first floor and top three floors are handled by two Worthington 75-ton Freon-12 compressors complete with condensers, pumps, water coolers and five central station units with chilled water and steam coils. Total capacity is 1050 tons.

Builders and owners: Uris Bros. Consulting engineer: Henry Oehrig. Air conditioning contractor: Raisler Corp. Architects: Emory Roth & Sons. All of New York.

RICE HOTEL MULTIPLIES COMFORT-COOLING WITHOUT REQUIRING MORE ROOM

Last year, Houston's Rice Hotel completed air conditioning its entire building, including a thousand guest rooms, dining rooms and meeting rooms, by installing three Worthington 600-ton centrifugal chilled water syatems.

This equipment, utilizing Freon-11, replaced ammonia refrigeration equipment having a capacity of 350 tons, yet occupies no more space than formerly.

Worthington equipment was selected primarily because Worthington could provide 100% equipment of its own make. The compressors are driven by Worthington steam turbines and steam condensers.

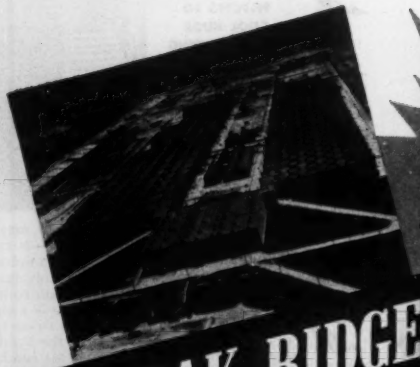
Engineer: Reg. F. Taylor. Mechanical Contractor: Charles G. Heyne & Co. Architect: Kenneth Franzheim. All of Houston.

WORTHINGTON

AIR CONDITIONING AND REFRIGERATION

INVESTIGATE MORE WORTH WITH WORTHINGTON

Consult Classified Telephone Directory for nearest Worthington distributor. Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J., specialists in air conditioning and refrigeration for more than 50 years. A.1.2



Another of the world's great engineering projects,

The OAK RIDGE Atomic Energy Plant

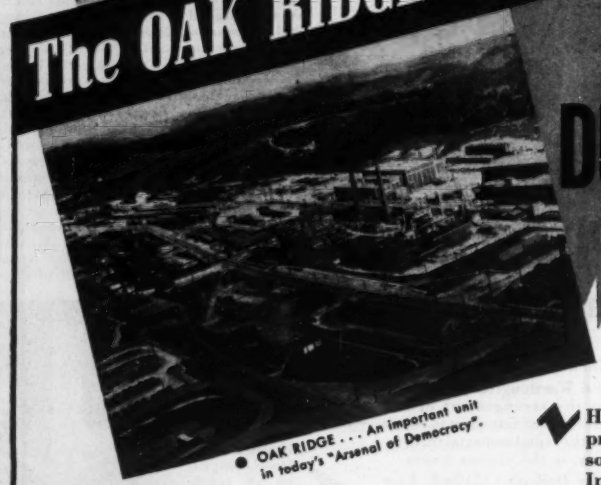
uses

Grant Wilson

ASBESTOS PROTECTED

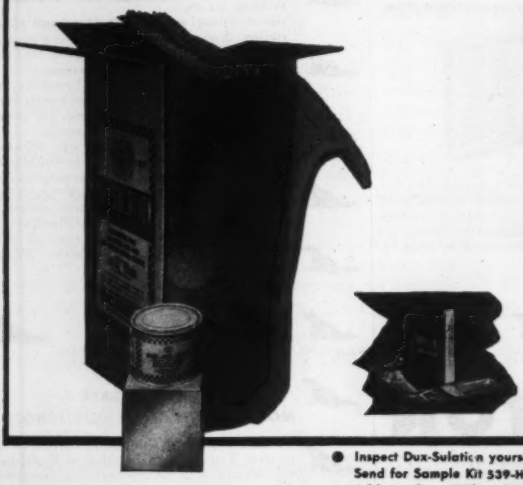
DUX-SULATION

for peak efficiency in duct insulation



● OAK RIDGE . . . An important unit in today's "Arsenal of Democracy".

- **High thermal and acoustical insulating properties . . . K factor of .27 BTU and sound absorption approximately 61%. Integral, woven asbestos membrane.**
- **Easy to handle, easy to install *correctly*, can't be crushed or cracked, springs back to original thickness if compressed. Supplied with special glue and tape, no "fasteners" needed.**
- **Constant insulating values. Can't "powder", shift or sift; no thin spots, even at corners. No deterioration of any kind, no *change* of any kind.**
- **Perfect adhesion, flexible, conforms to uneven surfaces. Tough enough to be installed in the shop and still withstand all necessary handling. Not just "adapted" for duct work, but specifically engineered for duct application ONLY!**



Grant Wilson inc.

ASBESTOS DUX-SULATION STANDARD

● **Inspect Dux-Sulation yourself. Send for Sample Kit 539-H today. Address: Grant Wilson, Inc., Board of Trade Bldg., Chicago 4, Ill.**

IN NEW YORK CITY: Air Conditioning Utilities Co., 8 West 40th Street, New York 18, N. Y., LOngacre 3-4280.
IN CANADA: Atlas Asbestos Co. Ltd., Montreal, Toronto, Winnipeg, Vancouver.

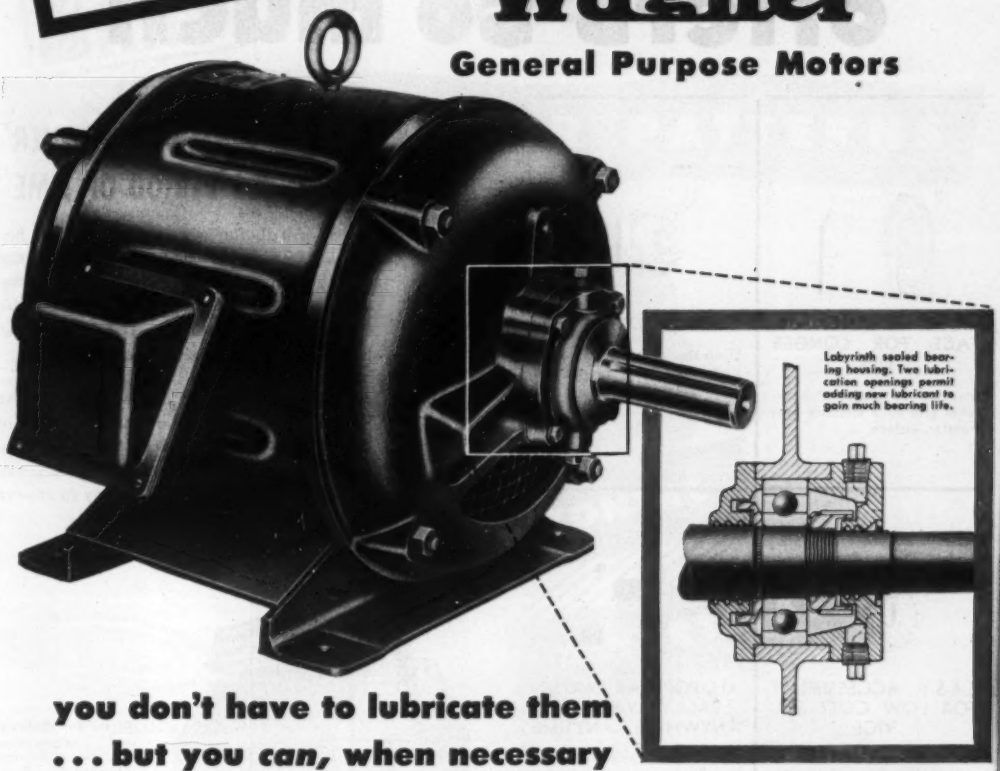
Wagner®
ELECTRIC MOTORS
...the choice of leaders in industry

for longer useful motor life –

YOU CAN'T BEAT

Wagner

General Purpose Motors



you don't have to lubricate them ... but you *can*, when necessary

Wagner Steel-Frame Motors have been *proved*—durable, dependable and trouble-free by more than twenty years of hard usage in industry after industry. They have a reputation for long, useful life. Among the many engineering features that have built this reputation is the ample sized, sealed, bearing housing.

Wagner bearing housings are effectively sealed against the entrance of dirt or grit that cause rapid wear. You don't have to lubricate the bearings (motors in the smaller frame sizes will often operate for the life of the unit without lubrication) but, Wagner Motors are provided with two lubrication openings—you *can* lubricate them, to add much useful motor life where the motors are used in tough applications.

Wagner's new Bulletin MU-131 gives full information on the proper lubrication of electric motors—write for your copy. Thirty-one branches, located in principal cities, are ready to assist you whenever you have a motor problem. Consult the nearest branch, or write us.

Wagner Electric Corporation
1891 WE 1951

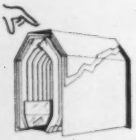
WAGNER ELECTRIC CORPORATION
6370 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

BRANCHES IN 31 PRINCIPAL CITIES

MU-9

No other Heater offers so much



MORE HEATING SURFACE FOR LONGER LIFE

Standard 10 gauge, 4" boiler tubes give more effective heat transfer surface.

SEPARATE DRAFT FAN

Eliminates cold blast at every start. Especially appreciated by employees.

EASY ACCESSIBILITY FOR LOW COST SERVICE

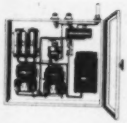
All accessories mounted on outside. Can be serviced without dismantling.

ALL POPULAR PARTS— EASILY AVAILABLE ANYWHERE, ANYTIME

All standard products of nationally known manufacturers.

RIGID CONSTRUCTION FREE FROM VIBRATION

Low fan speed, heavy-duty shaft, large, self-aligning ball bearings.



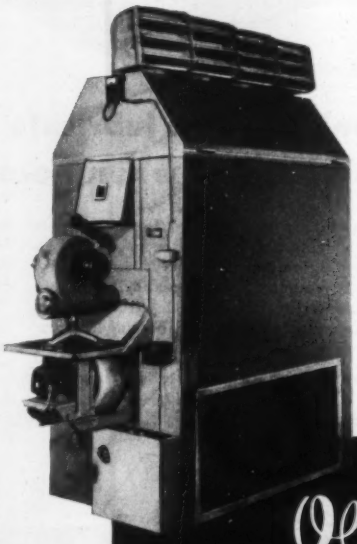
DUST-TIGHT, DAMP-PROOF CONTROL BOX

Within sight and reach of all burner adjustments. Control circuit 110 v/t.

LESS MAINTENANCE OVER A LONGER PERIOD OF TIME

Every installation shows that Olson has proven to be the heater that requires the least amount of maintenance. After many years of constant, round the clock service, the Olson heater will still provide clean fast heat where and when it's needed.

And in every case the initial cost was low, in fact, only a fraction of the cost of more complicated systems — Why Not get all the facts about Olson Heaters — Write today and Olson engineers will be happy to answer your questions on heating.



Write for Bulletin and engineering data sheet showing horizontal and inverted models plus other installation data and information.

Olson

ARTHUR A. OLSON & CO.

Gas, Oil, Coal or Dual Gas and Oil

BROAD ST. · CANFIELD, OHIO

BARBER COLMAN

CEILING OUTLETS *feature*

ADJUSTABLE AIR PATTERNS

MODEL "J" CEILING OUTLET
Circular type, surface or flush mounting, supply or exhaust or both. Integral volume control. Write for Bulletin F-4085-1.

SQUARE CEILING OUTLET
Made to fit and blend into acoustical tile ceilings. Key-operated control provides air pattern adjustment. Write for Bulletin F-4728.

★ LOW NOISE LEVEL ★ LOW PRESSURE DROP ★ ENGINEERED FOR COMFORT CONDITIONING

BARBER COLMAN

NATION-WIDE SALES AND ENGINEERING SERVICE

BARBER-COLMAN COMPANY, 1228 Rock St., Rockford, Ill.

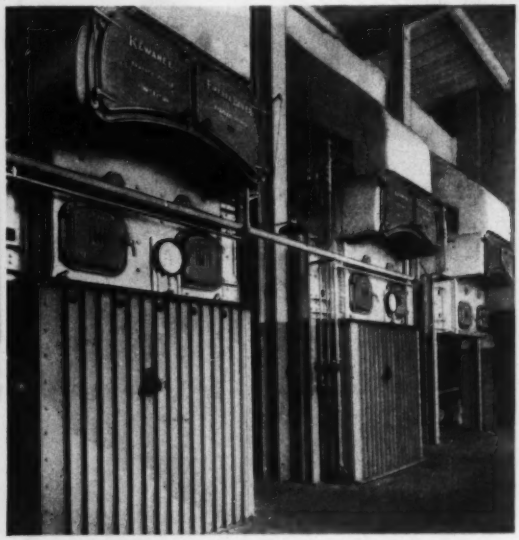
Where modern standards of heating match the pace of new teaching methods

VOCATIONAL TECHNICAL HIGH SCHOOL
Hammond, Indiana

Vocational training at its best! Embryo printers set type and run the presses . . . machinists operate lathes and drills . . . doing is added to theory.

L. CROSBY BERNARD, Hammond, *Architect*
LEO BESOZZI, Hammond, *Consulting Engineer*
FRANK S. BELLIS, Berwyn, Ill., *Heating Contractor*

KEWANEE STEEL BOILERS



In this up-to-date boiler room a battery of 3 Kewanee Boilers for Oil Firing; operated at 15 lbs. wp; produce heat for 42,500 sq. ft. of steam radiation . . . *plus generous overloads*. They have a total rating of over 10 million Btu hourly.

The vocational high school at Hammond, Indiana is an outstanding example of the modern thinking which goes into the construction and equipment as well as the teaching methods of America's new schools.

Located in the midst of an important industrial area the pupils are taught basic trades by working at them in the class rooms. The building itself is the last word in modernity . . . functionally arranged, well lighted and ventilated and *heated with Kewanee Steel Boilers.*

Considering the advanced thinking which went into this fine structure, the logical choice of heating boilers was Kewanee. For, during 80 years devoted to designing and building boilers, Kewanee has kept pace with the ever increasing need for greater reliability and flexibility combined with economy in the use of fuel.

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS
Eastern District Office: 40 West 40th Street, New York City 18
Division of American Radiator & Standard Sanitary corporation

BUILDING BETTER BOILERS OVER 80 YEARS

Serving home and industry

AMERICAN STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · [illegible]

NOW 3 GREAT PIPE INSULATIONS

Amocel

joins Unibestos in the UNARCO line of asbestos pipe insulations

...up to 650°F.

Answering the demand for a jacketed pipe insulation for use in the lower heat ranges, UNARCO now offers Amocel — for temperatures up to 650°F. Like Unibestos, Amocel is made of Amosite asbestos fibers bonded with an inorganic binder. For pipe sizes from ½" through 12", in Standard thickness only. Light in weight. Highly efficient. Durable.

UNIBESTOS
...up to 750°F.

UNIBESTOS
...up to 1200°F.

2 GREAT PIPE INSULATIONS — Unibestos No. 750 and No. 1200 — long have been America's outstanding insulations in their respective temperature ranges. Regular production for pipe sizes from ½" through 24" in popular thicknesses through 4". Other thicknesses and sizes available on order.

We want you to have our Catalog — It gives you complete information on Amocel and Unibestos Pipe Insulations; Unibestos Insulating Block; Cements and Finishes; Flexible Insulations; Metal Mesh Blankets; Tailored-to-Fit Insulations; Asbestos Packings and Gaskets; Asbestos Textile Products . . . Just drop us a line today requesting that we send you UNARCO Catalog No. 76-109.

UNARCO

UNION ASBESTOS & RUBBER COMPANY

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to Net More Profit from your Contracts...

Land the BIG ones

ALDRICH

HEAT-PAK BOILER-BURNERS

- APARTMENTS
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- DEFENSE PLANTS
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The big jobs net the high profits. To land those big contracts, make your bid with Aldrich Heat-Pak Boiler-Burners. It's the logical line to push for any size steam or hot water system — in seven sizes, delivering up to 808,000 BTU per hour. Engineered for fuel-saving *complete* combustion, with vertical fire-tube boilers for highest efficiency. Aldrich units come shipped *complete*, ready to set in place and connect. And for a sales clincher how's this: Boilers when specified can be furnished with interchangeable oil or gas burner provision at no extra charge permitting ready conversion in the field. Write for details today, furnishing name of nearest jobber.

Jobber inquiries invited

ALDRICH HEAT-PAK PRODUCTS

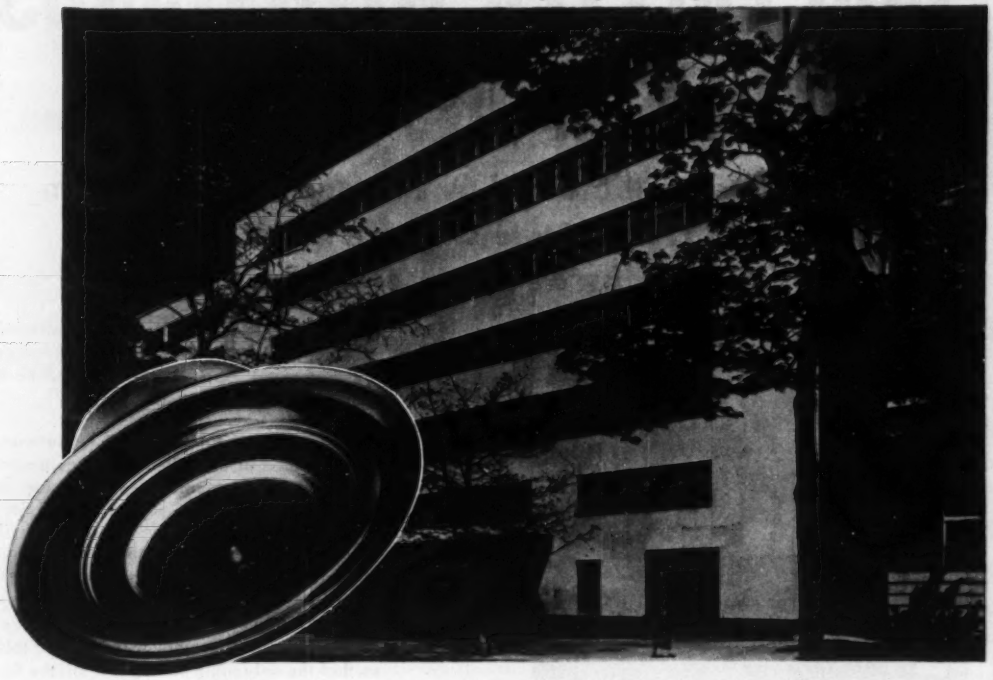
ANOTHER BREEZE MARK PRODUCT

the ALDRICH Company

103 Williams Street, Wyoming, Illinois

A subsidiary of Breeze Corporations, Inc.

Architects and Engineers: Albert Kahn Associated Architects and Engineers, Inc., Detroit, Michigan
Mechanical Contractor: Standard Engineering Co., Washington, D. C.



FOR APPEARANCE . . . FOR EFFICIENCY

kno·draft adjustable air diffusers

From first-floor pressroom to seventh-floor offices, The Washington Post's new building is completely air conditioned. Distribution is through Kno-Draft *Adjustable* Air Diffusers—smart in appearance, unobtrusive and, above all, *efficient.*

There are *no drafts* with Kno-Draft *Adjustable* Air Diffusers. Air distribution is gentle, maintaining an even temperature throughout the conditioned space. Air flow pattern and volume can be adjusted *after* installation—an important factor in operating efficiency and in reducing preliminary engineering.

Kno-Draft *Adiustable* Air Diffusers can be used in their natural spun aluminum finish, or painted to blend with ceilings. They are "at home" in either modern or traditional surroundings.

Let Connor Engineering Service work with you on your next air conditioning "specs." There are types and sizes of Kno-Draft *Adjustable* Air Diffusers for every requirement.

KNO-DRAFT DATA BOOK: Complete specifications, engineering and installation data on Kno-Draft *Adjustable* Air Diffusers. To get your copy, simply fill in and mail the coupon. No obligation, of course.

TRADE MARK "KNO-DRAFT" REG. U. S. PAT. OFF.

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Danbury, Connecticut
Air Diffusion • Air Purification • Air Recovery
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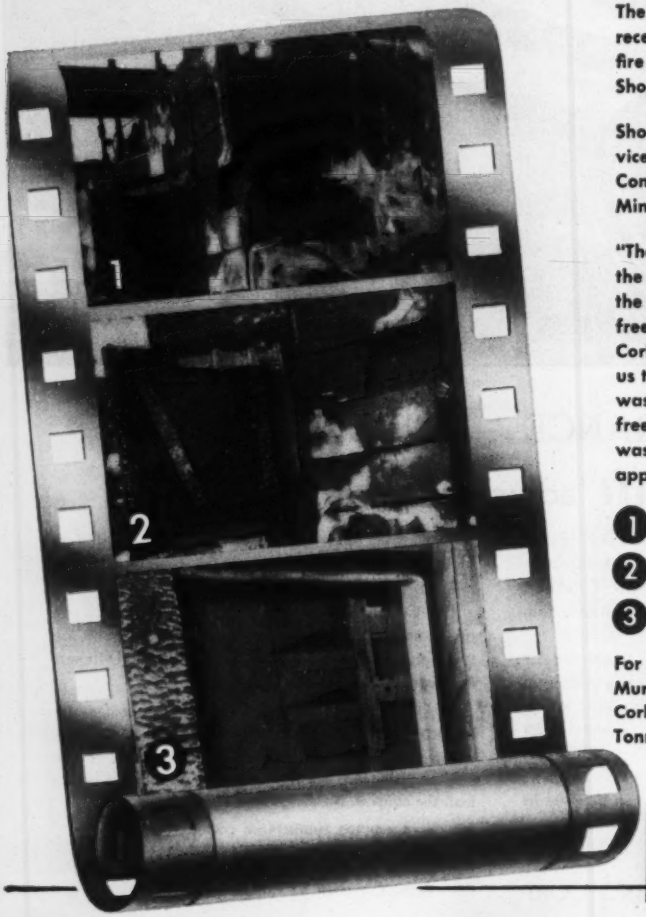
W. B. CONNOR ENGINEERING CORP.
Dept. G-91, Danbury, Connecticut

Please send me, without obligation, my copy of the Kno-Draft Air Diffuser Data Book.

Name .....
Position .....
Company .....
Street .....
City ..... **Zone** ..... **State** .....

FOOD FREEZER WITHSTANDS ST. PAUL'S WORST FIRE!

Freezer Contents, Protected by Mundet Cork Insulation, Found in Solid Frozen State Day After Fire . . . Food Approved for Sale by Health Inspectors.



The Cut Price Super-Market was destroyed recently, in a spectacular two million dollar fire that razed most of the Highland Park Shopping Center in St. Paul.

Shortly after the fire, Mr. Neil B. Herman, vice president of the Allied Store Equipment Company, Mundet sales representative in Minneapolis, sent us this report:

"The amazing thing about this fire was that the only part of the store left standing (even the brick walls were gone)—was the walk-in freezer, insulated with 6 inches of Mundet Corkboard. The operators of the Market told us that the only thing salvaged from the fire was all of the frozen food which was in this freezer. The day after the fire, the frozen food was still in a solid frozen condition and was approved for sale by the Health Inspectors."

1. *Walk-in freezer at Cut Price Super-Market, still intact and serviceable after 4-alarm fire.*
2. *Charred exterior of freezer door offers evidence of surrounding heat during fire.*
3. *This unretouched photo taken after the fire shows undamaged interior of the freezer.*

For information on Mundet Corkboard and Mundet Insulation Services, write to Mundet Cork Corporation, Insulation Division, 7101 Tonnelle Ave., North Bergen, N. J.

MUNDET
CORK INSULATION

ATLANTA: 339-41 Elizabeth Street, N.E.
BALTIMORE 30: 612 Battery Ave.
BOSTON: 57 Regent St., North Cambridge 40
CHARLOTTE, N. C.: 507 S. Cedar Street
CINCINNATI 2: 427 West 4th Street
DALLAS 10: 601 Second Ave.
DETROIT 21: 14401 Prairie Street
HOUSTON 1: Commerce and Palmer Streets

Mundet district offices are conveniently located coast-to-coast.

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NEW ORLEANS 16: 315-25 N. Front Street
NEW YORK 17: 331 Madison Ave.
PHILADELPHIA 39: 856 N. 48th Street
ST. LOUIS 9: 3176 Brannon Ave.
SAN FRANCISCO 7: 440 Brannan Street

In Canada: Mundet Cork & Insulation, Ltd. 35 Booth Avenue, Toronto

Write us for name of our nearest representative if there is no Mundet office in your city.

AIR CONDITIONING

New-born babies get constant temperature and humidity control in nurseries of such G. E.-Air Conditioned hospitals as Wesley Memorial, Wichita, Kans.; State Sanatorium, Oakdale, Iowa. Fresh air is constantly circulated. Nurseries can be heated at the same time other parts of building are being cooled.

Year 'round comfort for entire Navarro County Hospital, Corsicana, Texas, will be provided by 111 G-E room units, plus G-E refrigeration machines and central plant conditioners. Architect: W. G. Clarkson & Company, Fort Worth; Consulting engineer: Leonard Kanto, Fort Worth; General contractor: Campbell & Kay, Tyler; Air Conditioning contractor: Beals Plumbing & Heating Co., Fort Worth.

G. E. Helps Hospitals Cut Air Conditioning Costs

Budget-minded hospital men select flexible G-E Personal Weather Control for a nursery or a whole building

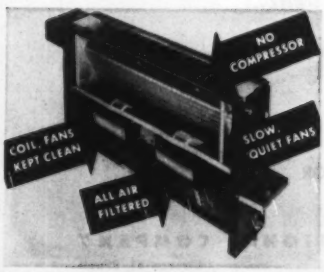
To help babies get a fine start—to give *all* patients a refreshing atmosphere—to improve working conditions for doctors and nurses—more and more hospitals choose G-E Personal Weather Control.

G. E.'S FLEXIBILITY means better results at lower costs. In the new Navarro County Hospital in Corsicana, Texas, for example, ventilation air will be supplied through grilles separate from the room unit. This independent fresh air system gives better humidity control, cuts power costs by greater use of outside air for cooling.

TO MEET THE NURSERY'S SPECIAL NEEDS, 100% outside air will be used in its central system. Even drug storage rooms will get limited, low-cost cooling. For cleanliness, all fresh air as well as room air will be filtered.

WRITE NOW for free data to General Electric Company, Air Conditioning Division, Sec. HP-3, Bloomfield, N. J. And ask, too, about G. E.'s sanitary water coolers for convenient drinking water supply at minimum expense.

SEE OUR CATALOG IN SWEET'S



*All air is filtered by G-E room units, maintaining capacity by protecting coils. Reduces cleaning, too. Units can be installed in wall or in handsome 9-inch cabinet. Chilled water for cooling and warm water for heating supplied through pipes from remote central plant.

You can put your confidence in—

GENERAL ELECTRIC

MULTI-VENT

T. M. Reg. U. S. Pat. Off.

Low Velocity Air Diffusion CEILING PANELS

in Pittsburgh's

GATEWAY CENTER BUILDINGS

Multi-Vent panels have been specified throughout for diffusing both cooled and heated air in all the interior bays of the first three office buildings, now under construction.

Eggers & Higgins, Architects
Meyer, Strong & Jones, Consulting

Selected for . . .

TRULY DRAFTLESS, NOISELESS AIR CONDITIONED COMFORT . . .
for over 8000 office workers, summer and winter.

Plus these great advantages possible only with Multi-Vent...

COMPLETE FREEDOM IN LOCATING MOVABLE PARTITIONS
Partitions may even bisect a diffusing panel without disturbing in any way Multi-Vent's incomparable over-all uniformity of room air movement, temperature, and humidity.

COMPLETE FREEDOM IN LOCATION OF LIGHTING FIXTURES . . .
for Multi-Vent panels are completely concealed in standard acoustical ceilings, and in no way interfere with interior design.

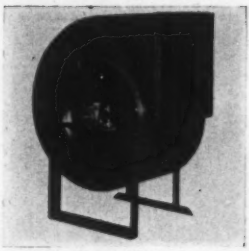
RADIANT PANEL HEATING AND COOLING EFFECT ADDS TO THE COMFORT FACTOR
The large areas of the ceiling which function as distribution plates for the Multi-Vent panels are heated or cooled to the temperature of the supply air.

See SWEET's Arch. & Eng. files or write for detailed literature.

MULTI-VENT DIVISION **THE PYLE-NATIONAL COMPANY**
1373 North Kostner Avenue Chicago 51, Illinois

Milwaukee Arena, scene for sports, shows, conventions, exhibits and other public attractions. Eschweiler & Eschweiler, Architects, Jos. H. Volk, Htg. & Vtg. Engr. Downey Heating Co., Htg. & Vtg. Contrs.

Fans for Fans . . .



Aeroplex Ventilating Fan. Non-overloading, Type AP. Nineteen centrifugal fans like this one, in sizes from 15" to 73" wheel diameter, provide supply and exhaust ventilation for Milwaukee's Arena.

. . . breezes for rooters. Absorbed in the contest, few of the crowd in the Arena are aware of the many Bayley fans humming quietly at their steady jobs of blowing in fresh air, sucking out the stale. Nonetheless, spectators, participants and attendants all realize the value of good ventilation and appreciate its contribution to their comfort and enjoyment.

Yes, good ventilation plays an important part in pleasing the patrons. The fans chosen for this part must give a star performance every time, all the time. Such outstanding dependability is just one of the many reasons Bayley fans have been the choice for the Milwaukee Arena and other major ventilating or conditioning installations.

Over 50 years of experience in design and manufacture of air handling equipment back the confidence placed in Bayley products by architects, engineers, contractors and owners alike. Sound design, careful choice of materials and components, fine workmanship and other quality factors substantiate this faith in Bayley apparatus. Then too, there's the wide selection of standard types and sizes, as well as special designs for the unusual applications. That means just the right unit for the job, — no makeshifts. Top this off with expert Air Engineering service and you'll see why Bayley equipment is the best bet for satisfaction in air handling systems.

Bayley representatives are on call in principal cities. Why not call or write us about *your* requirements, and make *your* next job a Bayley One?

Bayley AIR HANDLING EQUIPMENT

Performs better, — longer

BAYLEY BLOWER COMPANY

6400 W. BURNHAM ST. MILWAUKEE 14, WIS., U. S. A.

FIELD REPORT

...actual quotations reporting on Electromaze installation at Commerce Club, Minneapolis, Minn.

MR. J. WILLIAMS
proprietor, Commerce Club

CUSTOMER REPORTS:

"The Electromaze is perfect! Wouldn't change for anything!"

MR. WILLIAM H. GAUSEWITZ
Yale Engineers, Inc.

CONTRACTOR REPORTS:

"A very satisfactory installation! Very easy to service!"

Assembly view, Electromaze unit, Commerce Club, Minneapolis.

Upstream view. Note how diffuser plates are integral with each "file drawer", eliminating need for separate installation.

Downstream view. Note open construction permitting quick and easy servicing.

EASIEST TO INSTALL! Electromaze is a new kind of electrostatic dirt precipitator made up of individual cells that slide in and out like filing cabinet drawers. Cellular frames come in pre-fabricated sections. All you do is bolt the sections together. Contractors report that Electromaze requires 50% *less* time and effort to install!

EASIEST TO CLEAN! Due to extra-wide collector plate spacing in Electromaze cells, the filter can be quickly cleaned in place with a pressure hose. If manual cleaning should become necessary, the cells can be readily removed for cleaning. Ask your consulting engineer or contact your nearby Air-Maze representative. Air-Maze Corporation, Cleveland 5, Ohio.

AIR FILTERS
SILENCERS
SPARK ARRESTERS

AIR-MAZE
THE FILTER ENGINEERS

LIQUID FILTERS
OIL SEPARATORS
GREASE FILTERS

POINTS TO CHECK ✓

IN YOUR COOLING TOWER INVESTMENT

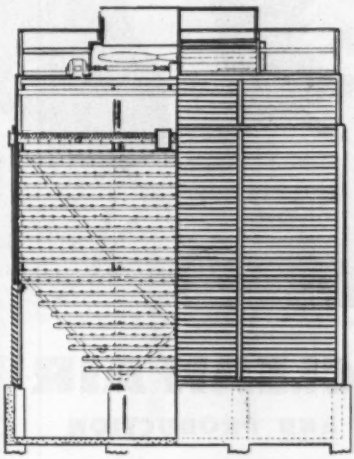
Here's what you get with a *C.H. Wheeler* Cooling Tower

GUARANTEED COOLING RESULTS—Names of installations near you sent on request. Repeat orders prove customer satisfaction. ✓

TWO TENTHS OF 1% DRIFT LOSS—Accurately placed Herringbone Drift Minimizers save on make-up water. ✓

MOST EFFICIENT WATER BREAK-UP—Wood fill arranged for best combination of wetted surface and water drop surface to speed cooling. ✓

NON-COLLAPSING FILL—Rugged 2" x 2" redwood members sawed diagonally—last the life of tower. ✓



GUARANTEED WIND-SAFE—Standard construction for 100 miles per hour— (75 mph is hurricane velocity). ✓

ADVANCED DESIGN PLASTIC FANS—on large towers pioneered by C. H. Wheeler—adjustable pitch blades —20-1 safety factor. ✓

CASINGS CONFORM—to architecture—to fire codes—may be many materials, including redwood, asbestos cement board, masonry, brick, properly painted steel, etc. ✓

NON-CORROSIVE ELEMENTS—Fill is slot-fitted; no nails. Nuts, bolts, etc., furnished in non-corrosive metals. Plastic fan blades. ✓

EASE OF ACCESS—into all parts of tower, *including the cooling space,* for regularity of maintenance. ✓

CUSTOM BUILT—Sure to satisfy your specific requirements. ✓

ENGINEERED FOR THE CLIMATE—50 years of successful experience in building for arid, tropical and cold areas, including severe icing conditions. ✓

INDUCED, FORCED, OR NATURAL DRAFT ✓

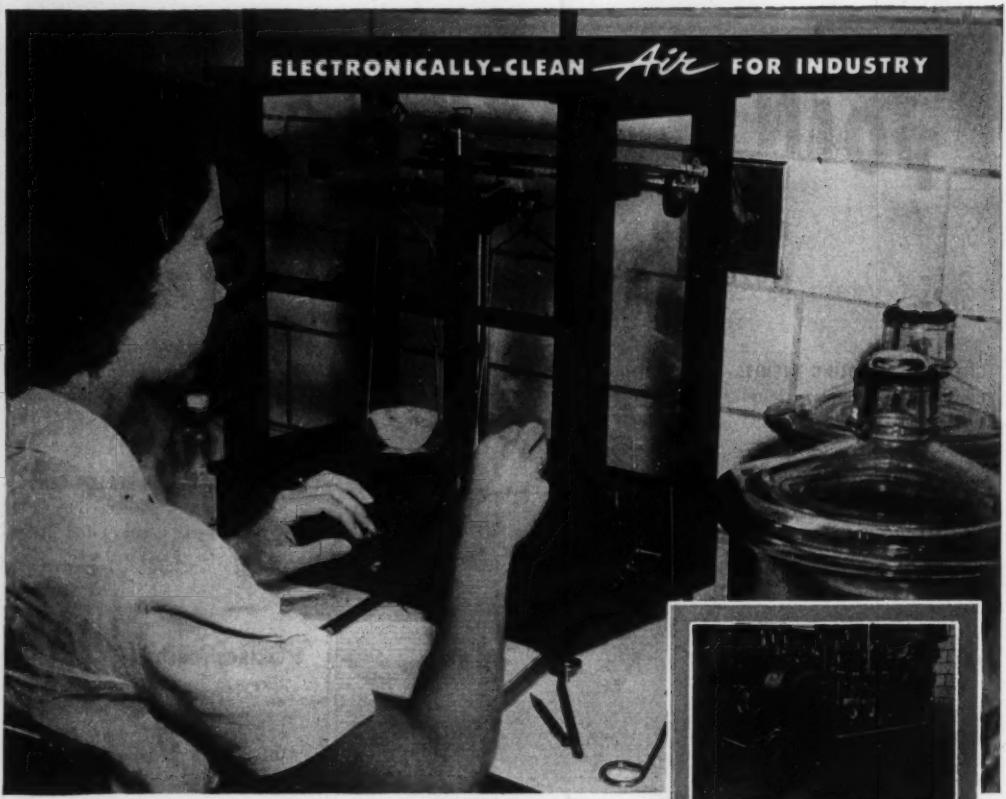
LITERATURE MAILED ON REQUEST ✓

C.H. Wheeler OF PHILADELPHIA

VACUUM REFRIGERATION—COOLING TOWERS—HIGH VACUUM PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—STEAM CONDENSERS—STEAM JET EJECTORS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY

C. H. WHEELER MANUFACTURING CO., 1826 SEDGLEY AVE., PHILADELPHIA 32, PA.

REPRESENTATIVES IN MOST PRINCIPAL CITIES



M & R Dietetic testing lab, where clean, conditioned air plays a vital role.

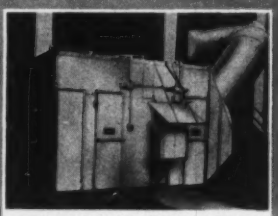
HOW SUPER-CLEAN AIR GUARDS QUALITY AND PRODUCTION

Manufacture of baby foods requires exceptional standards of cleanliness. Every vessel must be sterile—and the air itself pure. M & R Dietetic Laboratories, makers of CEREVIM baby cereal and SIMILAC powdered infant food, insisted on *really clean* air. So PRECIPITRON®—the *electronic* air cleaner—was installed. Now they remove harmful contaminants so small that they can be seen only with the finest Ultra Microscope.

PRECIPITRON also increases production. In one separating process, 20% of the dried milk was once discarded because air-borne contaminants passed through mechanical air filters. Now 100% is useable, and is better graded too. In the testing lab, precisely-controlled humidity and temperature help improve product uniformity and increase the efficiency of the technical staff.

There's a complete line of Westinghouse equipment to help you *put air to work*—with electronic air cleaning, air handling, or air conditioning. Contact your local Westinghouse-Sturtevant office, or write Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.

Westinghouse Hermetically-Sealed air conditioning compressors can be installed in an unventilated space.

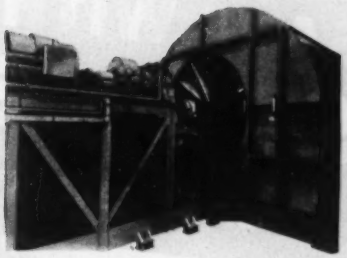


PRECIPITRON stops dirt *before* it enters the building. Its efficiency is triple the best mechanical cleaner.

There's nothing to remove from PRECIPITRON but dirt. It's periodically washed down drain with a water hose.

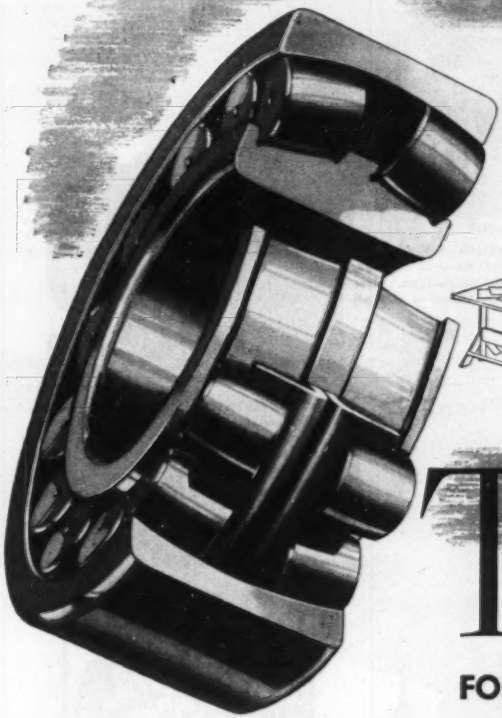
YOU CAN BE SURE...IF IT'S Westinghouse

J-80229



AIR-CONDITIONING
EQUIPMENT DESIGNER

SKF
BEARING
ENGINEER



TEAM

FOR EFFICIENCY AND ECONOMY

Over the years, SKF engineers have worked closely with engineers and designers in every field of industry. This co-operation, this *team-work*, has helped industry minimize friction in all types of equipment from the smallest motors to the largest blooming mills. Whether you are designing new equipment or looking for efficient, economical replacement bearings, look confidently to SKF for expert, proved advice. Depend on SKF to help you put the right bearing in the right place. 7270-L

SKF
BALL AND ROLLER BEARINGS

8 REASONS WHY SKF IS PREFERRED BY ALL INDUSTRY

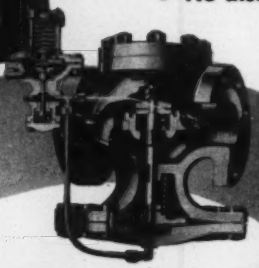
integrity • craftsmanship • metallurgy
tolerance control • surface finish
product uniformity • engineering service
field service

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.— *manufacturers of* SKF *and* HESS-BRIGHT *bearings.*

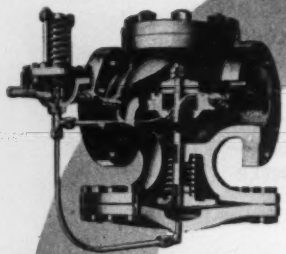
SAVE WITH SPENCE on all these jobs

Here are a few reasons why Spence Regulators give you accurate regulation and long, trouble-free life:

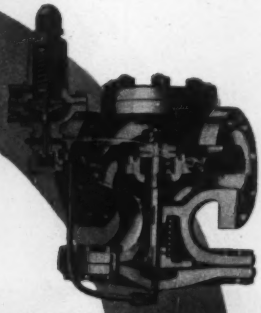
- **Single-seat Packless Construction**
- **Large Balanced Metal Diaphragm**
- **Sensitive Pilots**
- **SECO Metal Seats and Discs**
- **Springs out of path of steam**
- **No dismantling for inspection**



PRESSURE REDUCING—Self-operated, dead-end regulators powered by large, frictionless, metal diaphragms. Sizes ¼ in. to 12 in. Pressures to 600 psi 750 F.



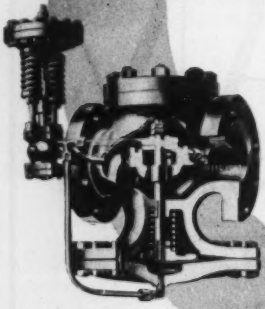
BACK PRESSURE CONTROL—Wide selection of sensitive pilots to meet exacting requirements. Initial pressure closing, guaranteed to shut tight. Packless construction, metal diaphragms.



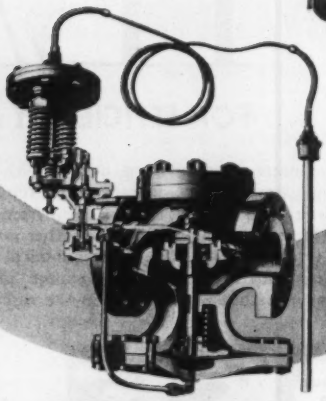
DIFFERENTIAL PRESSURE—Accurate control of delivery pressure over constant, adjustable differential from 3 to 150 psi above [illegible] fluid pressure.

WRITE FOR BULLETIN 350

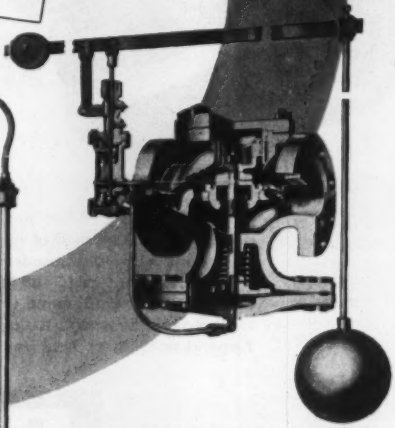
for complete details on Spence's line of automatic regulating valves



PUMP GOVERNOR—Constant or excess pressure control for steam pumps. Steam pressures to 600 psi 750 F, pump discharge pressures to 2000 psi.



TEMPERATURE REGULATING—Combined temperature and pressure control. No separate reducing valve required. Shuts tight, will not wiredraw or be damaged by overheating. Sizes to 12 in.



LEVER OPERATED—Pilot lever for connection by cable or mechanical linkage to floats or other devices. Slight actuator motion opens and closes main valve.

92-113

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

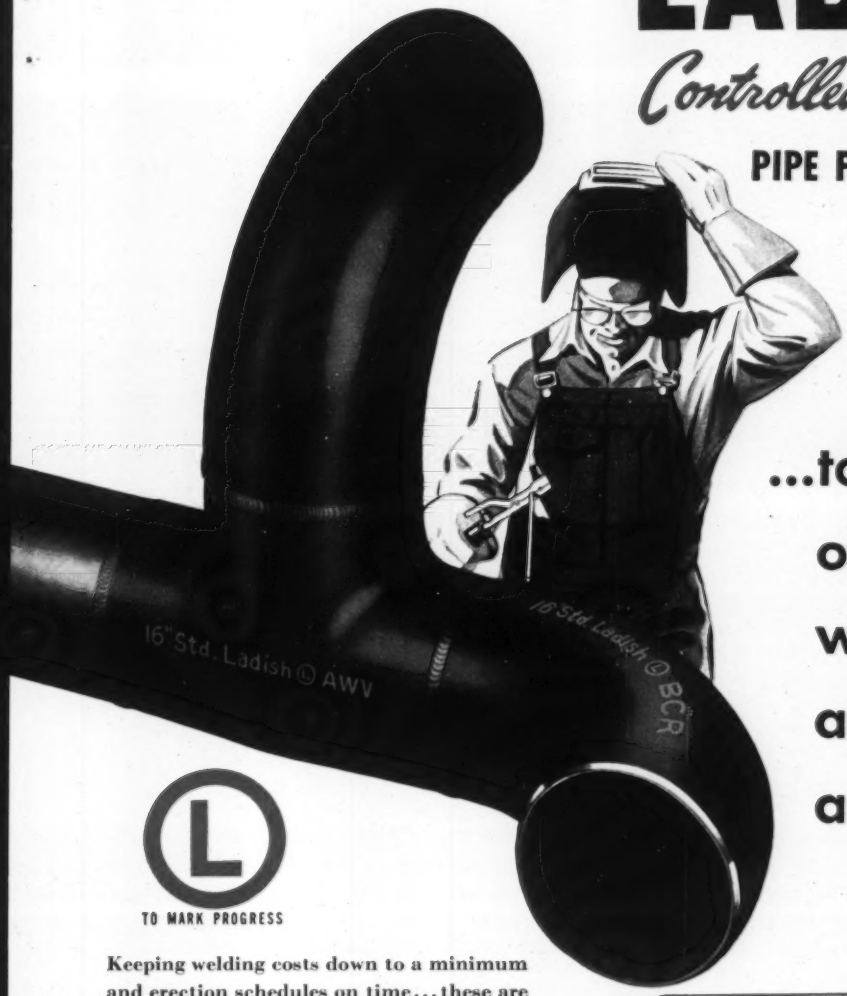
Spence

IT ALWAYS PAYS TO SPECIFY

LADISH

Controlled Quality

PIPE FITTINGS



...to be sure of sound welds and fast assembly

TO MARK PROGRESS

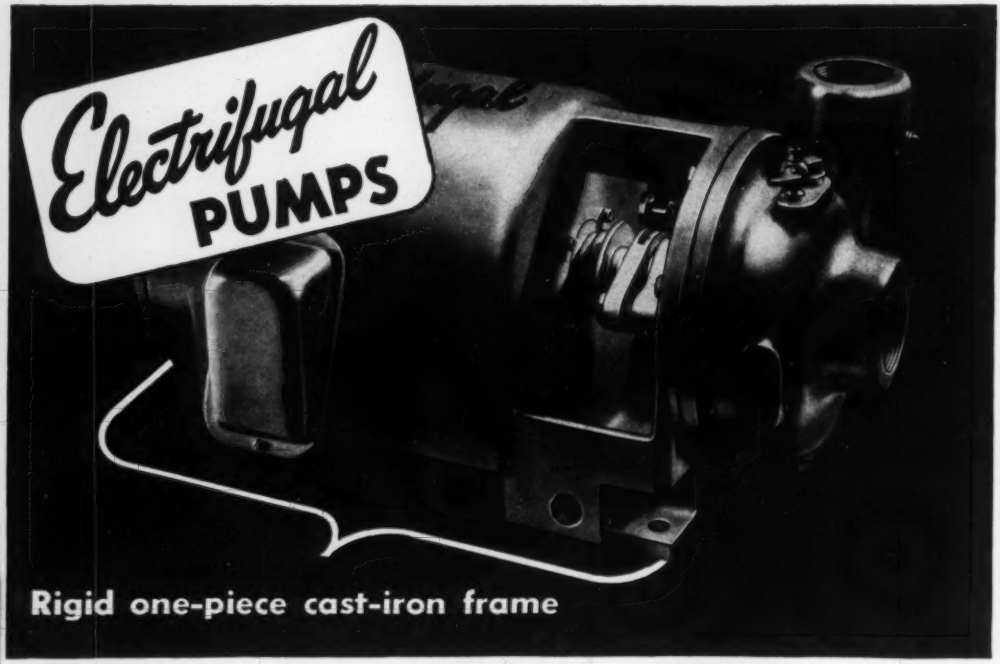
Keeping welding costs down to a minimum and erection schedules on time... these are important advantages you can assure to any piping job by installing Ladish Controlled Quality fittings. Metallurgical controls over materials and methods provide an assurance of uniform weldability in every Ladish fitting... and thorough inspection to rigid standards of physical dimensions and geometric accuracy assures fast piping assembly.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF... ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • Havana • Toronto • Mexico City



This is the difference between close-coupled pumps

THIS EXCLUSIVE FRAME DESIGN combines maximum space for packing maintenance with exceptional rigidity in a way that no pump assembled to a standard motor can do. Solid cast iron frame with no joints from motor end housing to pump casing assures permanent alignment.

Bearings are lubricated at the factory and should require no attention for years. The stuffing box carries plenty of packing and all parts are generously proportioned for heavy duty service. Wearing rings and shaft sleeves protect casing and shaft from wear and are easily replaced at low cost when worn. As a result, you will find exceptional freedom from high maintenance costs.

Unit Responsibility Means Dependability

Motor and pump are designed for each other and made in the same plant. You have one responsible source for both... one guarantee of satisfaction. Every Allis-Chalmers pump representative is a competent application engineer who will help you select exactly the right pump for your needs. And 94 Allis-Chalmers Certified Service Shops provide nation-wide factory approved service.

Talk over your pump selection problems with your Allis-Chalmers Authorized Dealer or Sales Representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletin 52B6140.

A-3337

Electrifugal, Texrope and Vari-Pitch are Allis-Chalmers trademarks.

ALLIS-CHALMERS

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

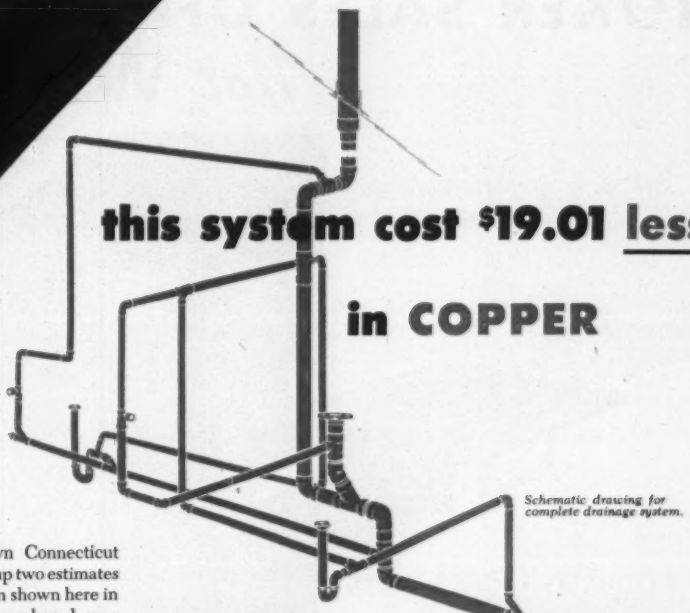
MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.

facts about Copper's economy

this system cost $19.01 less in COPPER



Schematic drawing for complete drainage system.

JAMES W. BURHOE, well-known Connecticut plumbing contractor, worked up two estimates on the soil, waste and vent system shown here in photograph and drawing: one was based on a cast-iron and steel installation; the other was based on an all-copper job—Type M tube with solder-type fittings. It would have cost the owner $19.01 more had he chosen to install cast iron and steel than it cost to install copper.

No one knows better than Mr. Burhoe why copper is first choice for soil, waste and vent lines. He says, "First of all, the job costs less because of the ease of handling and assembling copper tubes and fittings. Also, you can run vent stacks in a standard 4" stud partition. The smooth bore of copper tube reduces the possibility of stoppages and exposed lines in basement or utility room look neat and trim."

To all the features Mr. Burhoe points out, add the economies of shop fabrication and standard 20' lengths for long runs—and you'll agree that copper gives your customers a better job for less money. The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

5119

Mr. Burhoe demonstrates ease of making solder-type connection on a 3" all-copper soil line.

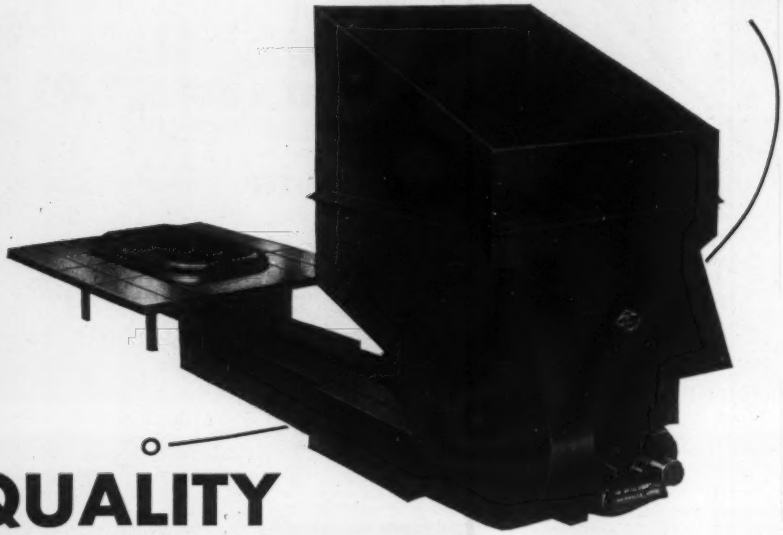
modern plumbing calls for

ANACONDA®

COPPER TUBES

The use of copper and copper alloys is now subject to the regulations of the National Production Authority.

STOKER SALES OFF?
Not Will-Burt!



QUALITY
Makes Sales When Sales Come Hard

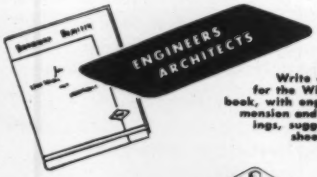
Will-Burt stoker sales are *up!*

Why? We're carrying on no special promotion — our advertising has not been increased. But for twenty years the knowledge has been spreading that Will-Burt is a good company with which to do business. Ask anyone who has specified, sold or used a Will-Burt stoker. The engineer or architect will say something like this: "Yes, it is accepted without question." The dealer or distributor: "It sells at reasonable prices and our profit isn't eaten up by excessive service calls." The user: "It must be good; we certainly have low coal bills and never any trouble."

Will-Burt stokers have always been designed and built better than the necessities demand.

We have always put *extra* quality into Will-Burt stokers, and it is now paying off in increased sales.

If you want to do business with a company whose integrity can never be questioned, whose product is above-average, and who feels business can be pleasurable as well as profitable, drop us a line. ***Now you know*** . . . Will-Burt quality makes sales when sales come hard.



Write on your letterhead for the Will-Burt stoker data book, with engineering facts, dimension and installation drawings, suggested specification sheets, etc. Valuable!

OTHER WILL-BURT HEATING PRODUCTS

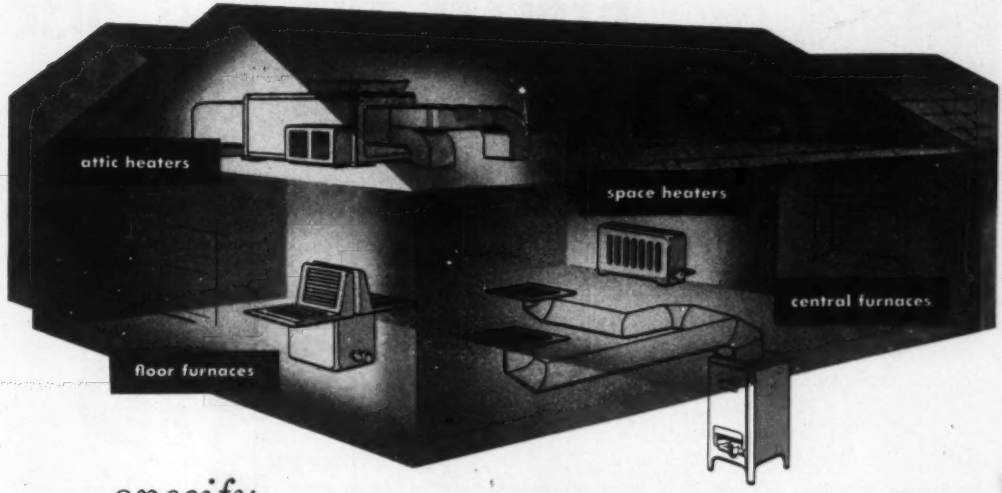
Gas and oil conversion burners

Residential hot-water heating boilers

WILL-BURT

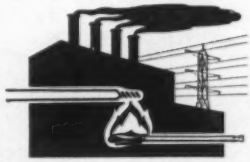
THE WILL-BURT COMPANY

DEPARTMENT H ORRVILLE, OHIO



specify

General Controls *B-60 all-gas control systems*



POWER PLANT...*in a hairpin!*

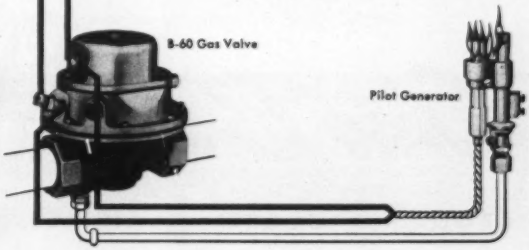
Electrical power, self-generated from a hairpin? Not quite, but when two tiny pieces of dissimilar metal are shaped into hairpin form and *heated by a gas flame*, an electric potential is produced.

General Controls have found a practical application for this laboratory miracle and developed it to the stage where sufficient power is generated to operate the B-60 All-Gas System *electrically* and independent of *outside* power sources. Specify the B-60 by General Controls for safety, comfort and economy.

100% safety shut-off available for Liquid Petroleum Gases.

T-70 Room Thermostat

Originated by General Controls and proved again and again by over 14 years of successful operation, in hundreds of thousands of installations, the B-60 All-Gas Control System provides the ideal method for remote thermostatic control of all types of gas fired heating appliances. In the unique B-60 system, electric remote thermostatic control with electrical control of the valve is provided, *yet no outside* electrical current is required. Because of its self-contained and self-generated power source, the B-60 system assures positive and uninterrupted operation at all times even when normal power sources are out of service. For floor furnaces, central furnaces, boilers, space heaters, or any gas fired heating appliance . . . for better control . . . for *safer* control, it's the B-60 by General Controls.



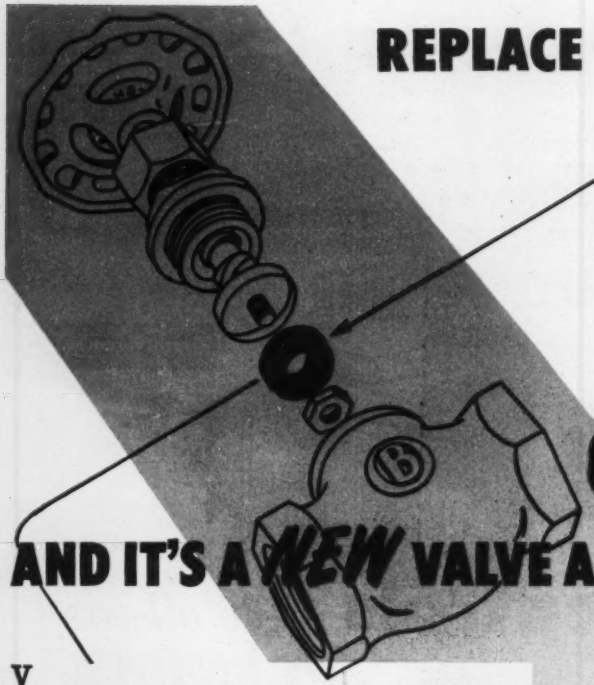
GENERAL CONTROLS

801 Allen Avenue — Glendale 1, California

FACTORY BRANCHES: Baltimore 5, Birmingham 3, Boston 16, Buffalo 3, Chicago 5, Cleveland 15, Columbus 15, Dallas 2, Denver 4, Detroit 21, El Paso, Glendale 1, Houston 6, Indianapolis 4, Kansas City 2, Milwaukee 3, Minneapolis 2, Newark 6, New Orleans, New York 17, Omaha 2, Philadelphia 23, Pittsburgh 22, Salt Lake City 4, St. Louis 3, San Francisco 7, Seattle 1, Tulsa 6, Washington 6, D.C.

DISTRIBUTORS IN PRINCIPAL CITIES

REPLACE THE *OLD* DISC



DISC RENEWAL QUICK AND EASY
Worn disc slips out of disc holder when disc nut is removed. New O-B composition disc slips on easily, held securely in place by the disc nut.

AND IT'S A *NEW* VALVE AGAIN

You can make a hit with your customers by eliminating for them the trouble and expense of frequently having to replace low-pressure valves on domestic water lines. O-B No. 3 Line valves featuring renewable composition discs can be kept in top operating condition for many years by simply renewing the old discs when they become worn. Re-fitted with a new disc which takes only a few minutes to change, these valves will shut off leaktight--just like a brand new valve.

O-B No. 3 Line valves also last longer because excessive wearing of either the seat or the disc is prevented by the free-swiveling disc holder. Once it makes contact with the seat, the disc stops turning. Further rotation of the handwheel develops a tight closure without danger of cutting or gouging the soft disc.

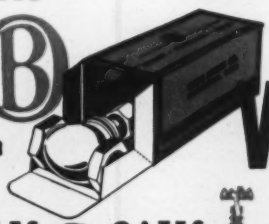
Costing no more than other first line valves for low pressure service, No. 3 Line valves with their extra long-wearing qualities will pay you an extra bonus in customer satisfaction.

On your next plumbing or heating job, specify O-B No. 3 Line valves. You will find them available at your nearby distributor of Ohio Brass valves.

OHIO BRASS COMPANY · M'ANSFIELD

O-B No. 3 Line valves
Globes and Angles Available
¼ to 2 inches in size.

4069-V



Ohio Brass VALVES

BRONZE GLOBES ANGLES GATES AND CHECKS

Improving a Proven Principle

SUPERIOR'S INDUCED DRAFT

Built to operate on the same proven principle as natural draft, Superior's *Induced Draft*, because of its built-in design, low-speed fans, and unique construction, assures maximum boiler capacity at high efficiency. It provides accurate control of draft conditions without the usual disadvantages of mechanical draft. Cleaner, quieter, and safer in every respect, it represents but one of the many "Designed by Demand" features which contribute to the overall efficiency and long life of Superior Steam Generators.

Superior Steam Generators are shipped completely assembled, backed by undivided responsibility • Burn gas or oil, or both • 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i. or for hot water • Write today for Catalog 304.

1. Tailored to the demands of the boiler, and built-in, Superior's *Induced Draft* regulates the air necessary for efficient combustion. Leaves front platform clear.
2. Full-width fan construction minimizes the danger of overworked or burnt-out tubes by providing an even draw across the entire tube area of the boiler.
3. *Induced Draft* eliminates the danger of forcing the products of combustion into the boiler room to spread dust, dirt, and unhealthful air throughout the building.
4. Especially-designed over-size fans run slower, minimizing wear and maintenance.
5. Quieter, low-speed fans eliminate the high-pitched whine commonly associated with forced mechanical draft.
6. Long-lived trouble-free operation assured by corrosion-resistant fans with outboard mounted bearings located out of the path of combustion gases.
7. Eliminates the expense of a large chimney.

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Factory, Emmaus, Pa.
Executive Offices, Times Tower, Times Square, New York 18, N. Y.

Heating?

Cooling?

Air Conditioning?

Process?

Here's How to Get the RIGHT Answer to your HEAT-EXCHANGE PROBLEMS

The right ratio of surfaces—the right materials—the right velocities—the right proportion between coil area and depth . . . there are dozens of factors that affect the efficiency, maintenance and service life of heat-exchange coils.

For best performance in your own application, the practical approach is to take full advantage of the unequalled engineering, research and design skill—the unequalled manufacturing and testing facilities—which Aerofin offers you.

To get the *right* answer—ask the Aerofin man.

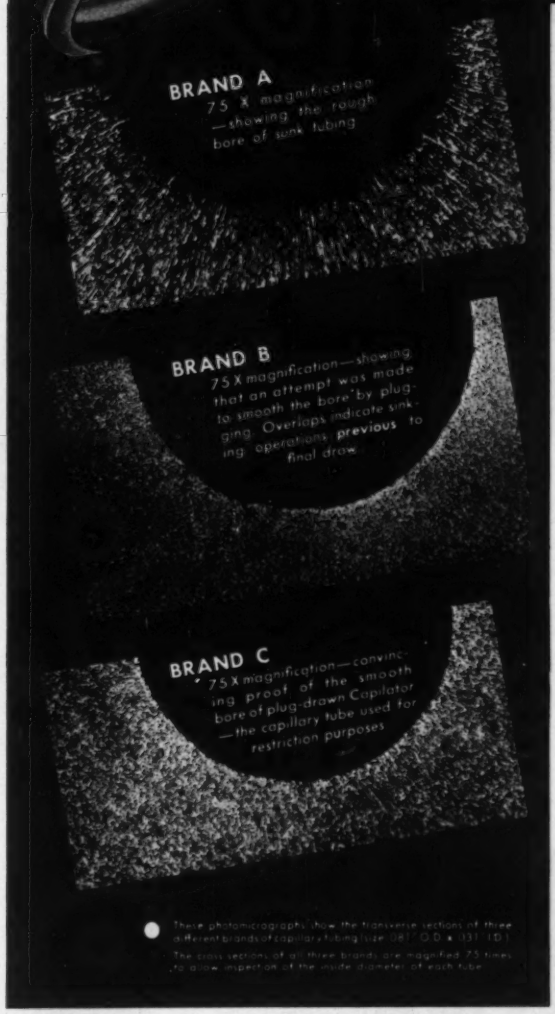
Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

AEROFIN CORPORATION

410 South Geddes St. SYRACUSE 1, N. Y.

The Camera Lens Proves

The Advantages of using WOLVERINE TUBE


BRAND A
75 X magnification—showing the rough bore of sunk tubing
BRAND B
75 X magnification—showing that an attempt was made to smooth the bore by plugging. Overlaps indicate sinking operations previous to final draw
BRAND C
75 X magnification—convincing proof of the smooth bore of plug-drawn Capilator—the capillary tube used for restriction purposes

These photomicrographs show the transverse sections of three different brands of capillary tubing (size .081" O.D. x .031" I.D.). The cross sections of all three brands are magnified 75 times to allow inspection of the inside diameter of each tube.

In Brand "C" you can immediately recognize the fine structure of the metal in Capilator.* You can see that it possesses a smoother inside surface which will permit longer tube life and more efficient flow control.

Just a quick comparison of these unretouched photomicrographs will readily reveal the difference between ordinary capillary tubing and Wolverine Capilator.

Bear in mind this difference extends to *all* Wolverine products. Rigid quality control measures are exercised "from ore to finished product."

Obviously, quality-controlled tubes stay in service longer and thus help to conserve not only the material from which they are made but also the costly labor that is required to make replacements. You can realize many advantages when you specify Wolverine seamless copper tube.

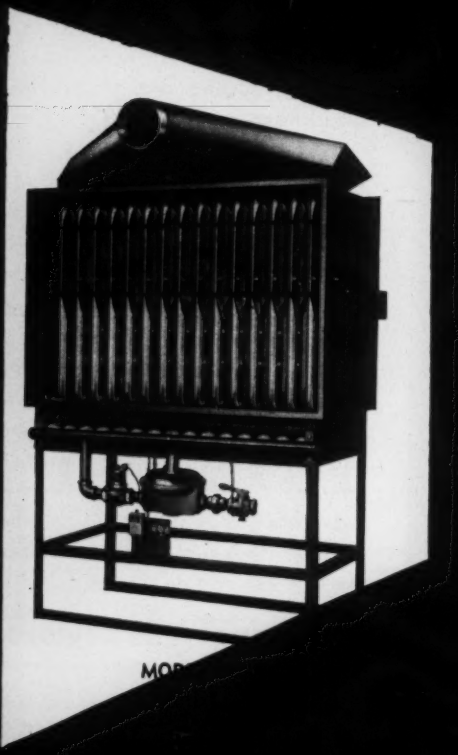
*Reg. U.S. Pat. Off.

WOLVERINE TUBE DIVISION
Calumet & Hecla Consolidated Copper Company
INCORPORATED
Manufacturers of seamless, non-ferrous tubing
1419 CENTRAL AVE. • DETROIT 9, MICH.

Sales Offices in Principal Cities — *Plants in Detroit, Mich. and Decatur, Ala.*

Wolverine Mill Depots:
DETROIT, MICH. • DECATUR, ALA. • HOUSTON, TEXAS • LOS ANGELES, CALIF.
LONG ISLAND CITY, N. Y. • PHILADELPHIA, PA. • PROVIDENCE, R. I. • ST. LOUIS, MO.

Export Department, 13 E. 40th St., New York 16, N. Y.



An ILLINOIS *Automatic* HEATING SYSTEM

CONTINUOUS FLOW CONTROL TYPE A

MORRISTOWN (N. J.) MEMORIAL HOSPITAL
JOHN H. & WILSON C. ELY, Newark, N. J., *Architects*
MEYER, STRONG & JONES, New York City, *Mechanical Engineers*
GERHARD HARTMAN, PH. D., New York City, *Hospital Consultant*
AUGUST ARACE & SONS, INC., Elizabeth, N. J., *Heating, Ventilating & Air Conditioning Contractor*

Series 48 Supply Valve

Series G Thermo Trap

Type A Valve

Enthusiastic teamwork and compact planning produced this masterpiece of building economy—a new 236-bed general hospital to serve 5 counties in Northwest New Jersey. It represents the "most beds per dollar" with direct construction costs 20% less than national average.

In keeping with this economical planning, a Type A ILLINOIS Control System was selected to represent maximum value. Although higher in first cost, its operation will reflect a sound economy year after year as well as giving the comfort and convenience of automatic heat perfectly controlled.

Three oil-fired boilers generate steam at 105 psig. for the laundry equipment. A 50 psig. system serves the kitchen, sterilizers and autoclaves. Another reduction to 10 psig. handles the air conditioning and ventilating coils, hot water generators and unit heaters. Finally, in three independently controlled zones, steam is reduced by Illinois Continuous Flow Type A valves to pressures varying from 1 lb. to 24 inches (Hg.) vacuum. Outdoor thermostats, in combination with vacuum pump controllers automatically govern the flow and temperature of steam to the standing cast iron radiators, producing a continuous output varied to meet weather demands.

Write for Bulletins

***Representative*, DUDLEY F. PARKER, 480 Broad Street, Newark 2, N. J.**

ILLINOIS ENGINEERING COMPANY
INCORPORATED 1900
RACINE AVENUE AT 21ST STREET • CHICAGO 8

NOW'S THE TIME TO "TIE IN" WITH

SHAFCONAIRE*

* formerly known as SHAFCO

Leader in the Overhead Oil-Fired Heating Market

That's right, Heating Men! There's no time like now . . . *right now* to get set with SHAFCONAIRE OverHead Heaters. They're big business boosters, extra profit producers. For SHAFCONAIRE, you know, is the original suspended oil-fired furnace known for years as SHAFCO. It's quality-built from end to end . . . designed especially for use in commercial and industrial buildings. Not just a domestic floor-type unit tilted horizontally on its side. And SHAFCONAIRE has been time-tested, thoroughly proved in use . . . the only furnace of its type backed by over 12 years actual operation in the field.

MODELS from 100,000 to 405,000 B.T.U. for single or multiple unit installation to meet a wide range of commercial and industrial heating requirements.

OVERHEAD HEATERS, INC.

(formerly SHAFCO Distributing Corporation)

1354 BOOK BUILDING • DETROIT 26, MICHIGAN

And here's something to talk about

4 ESSENTIAL FEATURES FOUND ONLY IN SHAFCONAIRE

1. BUILT-IN PLENUM CHAMBER—An exclusive patented feature that saves you plenty of time, trouble, and guess-work in making installations. Assures uniformly heated warm air output, eliminates on-the-job sizing and extra sheet metal work. Just top off ducts from end, top or both sides to meet installation requirements.

2. HEAVY DUTY CONSTRUCTION—Use of heavy gauge welded boiler plate assures long-life, trouble-free operation. No warping, no buckling, no burn-outs common to stamped steel construction.

3. INTERMEDIATE HEAT-TRAVEL SECTION—Patented intermediate chamber between refractory-lined firebox and heavy gauge heat exchangers serves to spread flame and eliminate impingement on metal. Permits expansion of hot gases, improves operating efficiency.

4. EFFICIENCY ENGINEERED HEAT EXCHANGER—Alternately spaced baffle plates in each of the heat exchanger sections effectively retard the flow of hot gases toward stack connection, permit maximum transfer of heat.

OVERHEAD HEATERS, INC.
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Please send me complete information and Price Lists on SHAFCONAIRE (formerly SHAFCO) OverHead Heaters.

*Name*_____

*Company*_____

*Address*_____

*City*_____ *Zone*_____ *State*_____

DON'T DELAY! SEND COUPON TODAY!

You'll get complete details and price information on the "hottest" bet for extra profits in the present heating market.

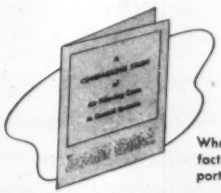
YOU figure it...

(4 to 1, we'll save you money)

Have you, *yourself*, figured out the difference in cost between cleanable filters and Fiberglas Dust-Stop* replacement-type filters? Using your *own* cost figures, follow the method shown above. Chances are about 4 to 1 that you'll save with Fiberglas Dust-Stop Air Filters.

Why? Because while rising labor costs have made filter cleaning more expensive, mass production has lowered the cost of Dust-Stop filters. In fact, on the basis of one 40c cleaning every 90 days, cleanable filters would have to last up to 14 years to match the cost of Dust-Stop Filters replaced at the same intervals . . . and you get a *new* filter with each change.

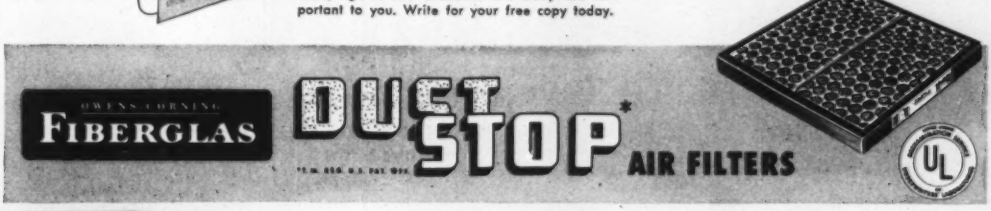
Check the facts: The "Comparative Study" shown below will help you. Send for it today. Owens-Corning Fiberglas Corp., Dept. 40-I, Toledo 1, Ohio.



Whatever your interest in air conditioning, the facts, figures and charts in this study are important to you. Write for your free copy today.

AIR FILTER COSTS

	Cleanable Filters	Dust-Stop Filters
ORIGINAL EQUIPMENT		
Original set of filters	$	$
Cost of spares required	$	NONE
Cost of cleaning equipment	$	NONE
TOTAL	$	$
MAINTENANCE COST (per cycle)		
Labor for inside cleaning	$	NONE
Overhead on labor	$	NONE
Solvents, adhesives, et.	$	NONE
Cost of outside filter laundry service	$	NONE
Cost of replacement filters	NONE	$
TOTAL	$	$
OVERALL COST SUMMARY		
Maintenance cost per yr.	$	$
Interest on orig. investment	$	$
TOTAL annual maint. + int.	$	$
Long-term cost (Total maint. + int.) × (No. of years service expected from cleanable filters)	$	$
Total comparative cost (Long-term cost) + (Original equipment cost)	$	$



FIBERGLAS INSULATION FOR AIR DUCTS

Ageless, light in weight, firesafe, moisture resistant, Fiberglas Duct Insulations can be quickly applied . . . have very high acoustical value . . . won't erode at 6,000 fpm . . . cost less than other insulations approaching them in thermal efficiency. Write for details.

*DUST-STOP is the trade-mark of Owens-Corning Fiberglas Corporation for impingement-type air filters made of glass fibers. FIBERGLAS is the trade-mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with fibers of glass.

nyb

Investigate STEELFIN!

It has everything you want in Heavy Duty Heat Surface

BUILT TO MEET MODERN INDUSTRIAL REQUIREMENTS FOR CONTINUOUS HEAT SERVICE UP TO 150 POUNDS STEAM PRESSURE

The rugged arc welded construction outperforms and outlasts heating elements made of thinner non-ferrous metals, avoids their expansion-contraction faults, yet has the same BTU efficiency.

Originated in 1922, it has an enviable record of dependable performance.

●

WRITE FOR YOUR COPY OF BULLETIN 514, ALSO 492 WHICH GIVES ENGINEERING DETAILS.

nyb

THE NEW YORK BLOWER COMPANY

SALES OFFICES • 32nd STREET and SHIELDS AVENUE • CHICAGO 16

FACTORY, LAPORTE, INDIANA

Oil Burner Primary Controls

Newly designed primary oil burner control for gun or rotary type oil burners. Available for intermittent or constant operation. Design includes some new features such as improved slip-friction clutch, which makes for trouble-free service.

One of many in the comprehensive line of White-Rodgers automatic controls for residential heating. *Send for catalog today.*

WHITE-RODGERS

Controls FOR REFRIGERATION HEATING AND AIR CONDITIONING

ST. LOUIS 6, MO.

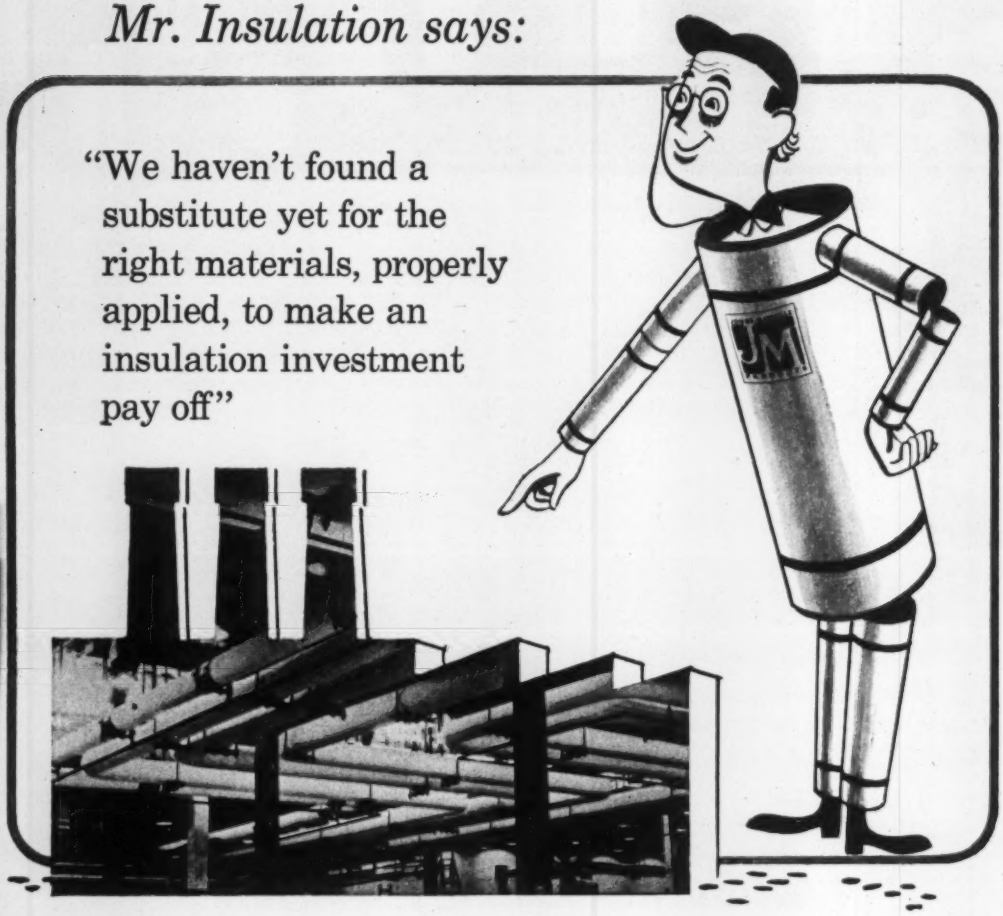
Branches:

NEW YORK 42 Vanderbilt Ave. CLEVELAND 2005 Euclid Ave. CHICAGO 548 N. Lake Shore Dr.

Resident Sales Engineers in all Principal Cities

Mr. Insulation says:

"We haven't found a substitute yet for the right materials, properly applied, to make an insulation investment pay off"



To be successful an insulation job must be properly engineered. In addition, it must have these two important ingredients:

1... THE RIGHT MATERIALS: service conditions vary greatly in industrial applications. That's why no one insulation can serve as a jack-of-all-trades on all jobs. For this reason, Johns-Manville uses asbestos and many other selected raw materials to produce the most complete line of insulations available. These insulations serve applications ranging between the extreme temperatures of 400F below zero to 3000F above.

2... THE RIGHT APPLICATION: Here again Johns-Manville's long experience in the field of insulation can be of value to you. Insulation engineering advice plus the services of insulation contractors trained in Johns-Manville methods of correct application are at your call.

If you are planning an insulation job why not put your problem up to insulation headquarters? Write Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville *first in* **INSULATIONS**

Complete

R·P&C VALVES

FIG. **409** Bronze Globe Valve

When you choose R-P&C Valves,

you can be sure of the same high quality of each one—from tiny ⅛" valves . . . to high-pressure, high-heat valves . . . and giant valves for handling huge volumes of liquids.

- You can get bronze, iron, steel—bar stock—iron cocks—and cast steel fittings. Two new numbers are PRESSURE SEAL BONNET and FORGED STEEL GATE. More new ones to come.
- Call your local R-P&C distributor today or write the nearest R-P&C district office.

"Intentionally Better" READING-PRATT & CADY VALVES

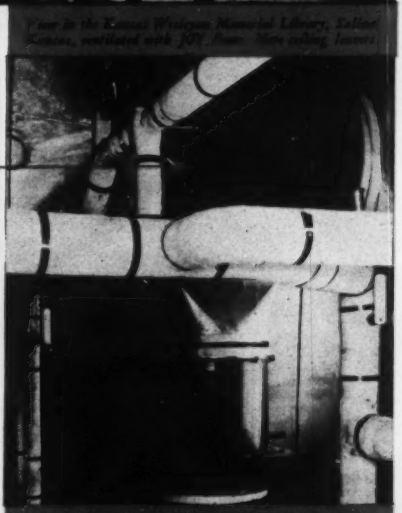
R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

QUIET, COMPACT, UNMATCHED IN VENTILATING EFFICIENCY

JOY AXIVANE® FANS

...BEST in Public Buildings

The compact, vaneaxial design of JOY AXIVANE Fans offers you important advantages of quiet, more efficient operation and savings on space requirements, installation costs, and power consumption. In addition, adjustable blades—a standard JOY feature—give you easy flexibility . . . you can make a simple on-the-job adjustment to meet new or changed conditions with greatest efficiency. ● For any ventilation job, check first with JOY—world's largest manufacturer of vaneaxial fans.



Write for Bulletin, or

Consult a Joy Engineer

WAD I 3520

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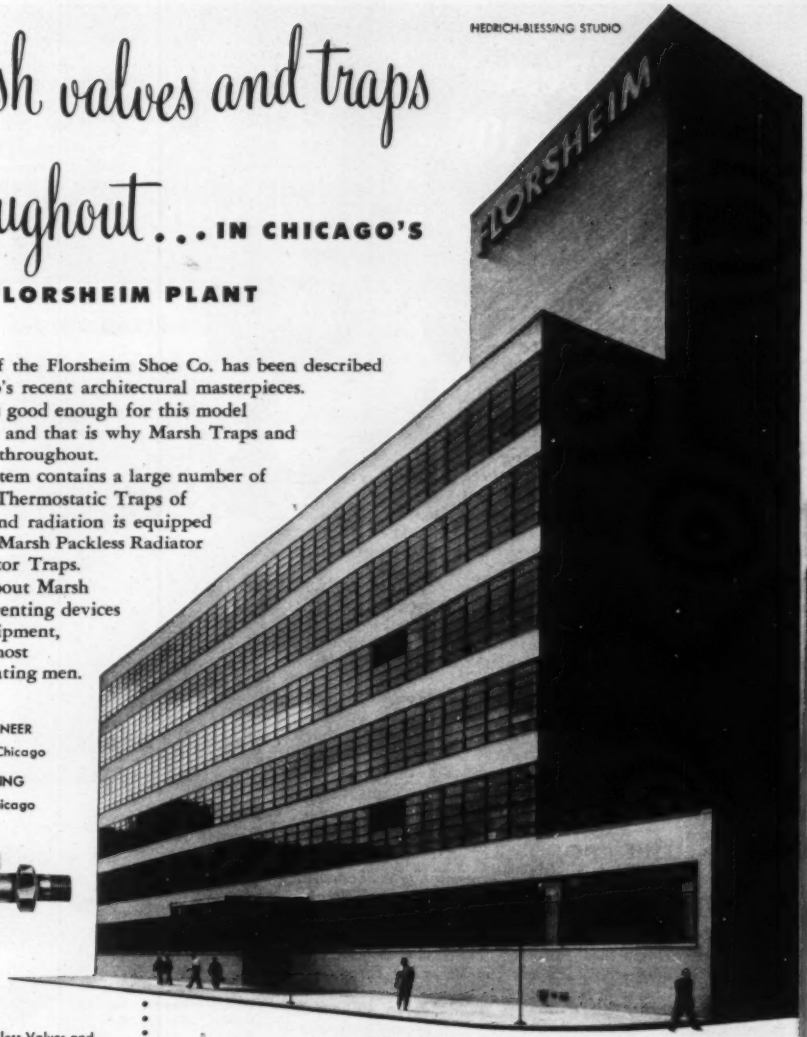
GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

Marsh valves and traps throughout... IN CHICAGO'S MODERN FLORSHEIM PLANT

HEDRICH-BLESSING STUDIO



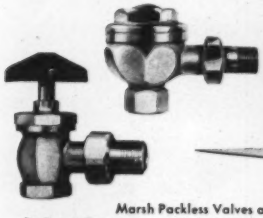
This new plant of the Florsheim Shoe Co. has been described as one of Chicago's recent architectural masterpieces. Only the best was good enough for this model establishment . . . and that is why Marsh Traps and Valves were used throughout.

The heating system contains a large number of Marsh Float and Thermostatic Traps of indicated types, and radiation is equipped with hundreds of Marsh Packless Radiator Valves and Radiator Traps.

Ask for facts about Marsh valves, traps and venting devices —time tested equipment, preferred by the most discriminating heating men.

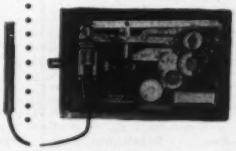
ARCHITECT & ENGINEER
Shaw, Metz & Dolio, Chicago

PLUMBING & HEATING
M. J. Corboy Co., Chicago



Marsh Packless Valves and Radiator Traps are used throughout in the Florsheim plant.

Marsh No. 12 Float and Thermostatic Trap — typical of many float and thermostatic traps, used in the Florsheim plant, which include Marsh No. 8 and No. 14 Traps.



MARSH *Tri-Trol* . . . heat control in step with the weather . . . EFFECTS BIG SAVINGS

MARSH HEATING EQUIPMENT COMPANY
Sales affiliate of Jas. P. Marsh Corporation, Dept. T, Skokie, Ill.

More and more owners of multiple occupancy buildings — from two apartments up to skyscrapers — are finding Marsh Tri-trol the answer to providing maximum comfort at minimum fuel cost. Tri-trol is a simple, low cost, easily installed regulator that pays its way many times over in savings. Ask for details.

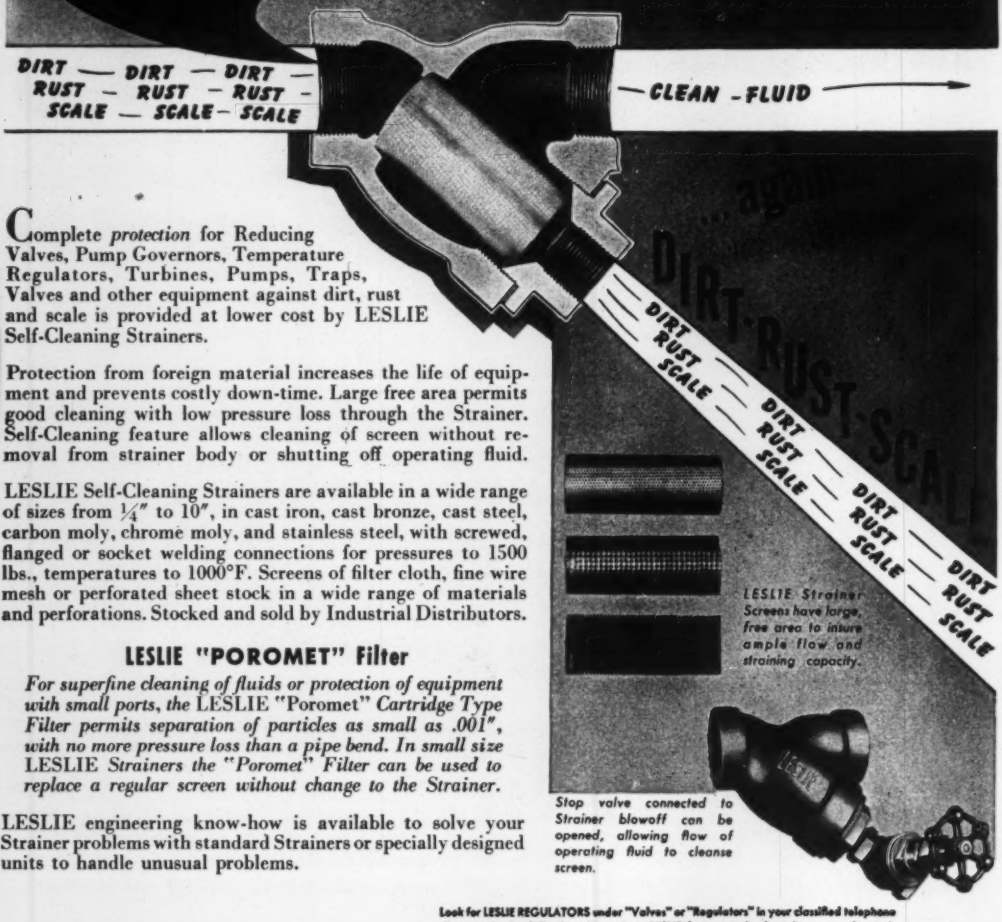
MARSH

Heating Specialties SINCE 1865

Your Best PROTECTION...

TRADE LESLIE MARK

SELF-CLEANING STRAINERS



Complete *protection* for Reducing Valves, Pump Governors, Temperature Regulators, Turbines, Pumps, Traps, Valves and other equipment against dirt, rust and scale is provided at lower cost by LESLIE Self-Cleaning Strainers.

Protection from foreign material increases the life of equipment and prevents costly down-time. Large free area permits good cleaning with low pressure loss through the Strainer. Self-Cleaning feature allows cleaning of screen without removal from strainer body or shutting off operating fluid.

LESLIE Self-Cleaning Strainers are available in a wide range of sizes from ¼" to 10", in cast iron, cast bronze, cast steel, carbon moly, chrome moly, and stainless steel, with screwed, flanged or socket welding connections for pressures to 1500 lbs., temperatures to 1000°F. Screens of filter cloth, fine wire mesh or perforated sheet stock in a wide range of materials and perforations. Stocked and sold by Industrial Distributors.

LESLIE Strainer Screens have large, free area to insure ample flow and straining capacity.

LESLIE "POROMET" Filter

For superfine cleaning of fluids or protection of equipment with small ports, the LESLIE "Poromet" *Cartridge Type Filter permits separation of particles as small as .001", with no more pressure loss than a pipe bend. In small size* LESLIE *Strainers the "Poromet" Filter can be used to replace a regular screen without change to the Strainer.*

LESLIE engineering know-how is available to solve your Strainer problems with standard Strainers or specially designed units to handle unusual problems.

Stop valve connected to Strainer blowoff can be opened, allowing flow of operating fluid to cleanse screen.

Look for LESLIE REGULATORS under "Valves" or "Regulators" in your classified telephone directory in the following cities where LESLIE factory trained engineers are located:

Albany, N. Y.
Albuquerque, N. M.
Atlanta, Ga.
Baltimore, Md.
Beaumont, Texas
Birmingham, Ala.
Boston, Mass.
Bridgeport, Conn.
Buffalo, N. Y.
Chicago, Ill.
Cincinnati, Ohio
Cleveland, Ohio
Dallas, Texas
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Detroit, Mich.
Duluth, Minn.
El Paso, Texas
Greensboro, N. C.
Greenville, S. C.
Houston, Texas
Kansas City, Mo.
Kingsport, Tenn.
Los Angeles, Cal.
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Miami Springs, Fla.
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ESTABLISHED 1900 LESLIE CO.

1187

237 Grant Avenue, Lyndhurst, New Jersey

FLOATLESS LEVEL CONTROLS • PRESSURE REDUCING VALVES • PRESSURE CONTROLLERS
SELF CLEANING STRAINERS • PUMP GOVERNORS • TEMPERATURE REGULATORS
• AIR HORNS • STEAM WHISTLES

HOFFMANIZE with a VENTING VALVE for EVERY NEED

RADIATOR VENTS • VACUUM • NON-VACUUM

2A
Vacuum Valve with 6 adjustable Vents. Hinged tongue siphon. Double Air-Locks. Size conn: ⅛".

1A
Non-Vacuum Valve. Six adjustable Vent Ports. Hinged tongue siphon. Size conn: ⅛".

70A
Single port, non-vacuum. Meets Fed. Spec. WW-V-151. Size conn: ⅛".

40
Single port, non-vacuum. Fine valve for low priced field. Size conn: ⅛".

MAIN VENTS • VACUUM • NON-VACUUM

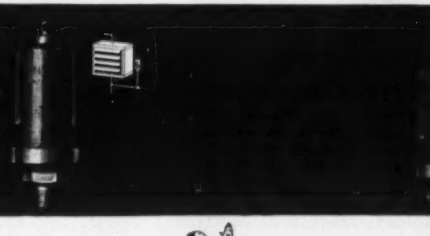
75-75A
Non-vacuum. 75 for venting medium size systems, 75A for larger systems. Size conn: ¾" male, ½" female.

4A
Non-vacuum. For venting air from small steam systems. Size conn: ¾" male, ½" female.

4
Non-vacuum. For small steam mains. Has no float. Size conn: ¾" male, ½" female.

76-76A
Vacuum Valves having Double Air-Locks. 76 for venting medium size systems, 76A for larger systems. Size conn: ¾" male, ½" female.

16A
Vacuum Valve for venting mains of small systems. Has Double Air-Locks. Size conn: ¾" male, ½" female.



HOFFMAN

VALVES, TRAPS, HOT WATER HEATING SYSTEMS
VACUUM AND CONDENSATION PUMPS

SOLD BY LEADING WHOLESALERS OF HEATING EQUIPMENT

HOFFMAN SPECIALTY COMPANY
1001 York St., Dept. CG-9 • Indianapolis 7, Ind.

MYSTIK

Self-Stik

DRI-PIPE

INSULATION

Holds Cold and Heat • Prevents Condensation

MYSTIK DRI-PIPE—the insulation with "self-stik" edges—goes on fast, saves time and money on installation. Ideal for low-temperature applications—on cold water lines, cold air ducts, refrigeration lines. Holds temperatures, prevents condensation and dripping, eliminates icing and frosting on refrigeration lines. Also has extensive other cost-cutting insulation uses—on warm water lines, warm air ducts and for sound deadening. Ask your supplier or . . .

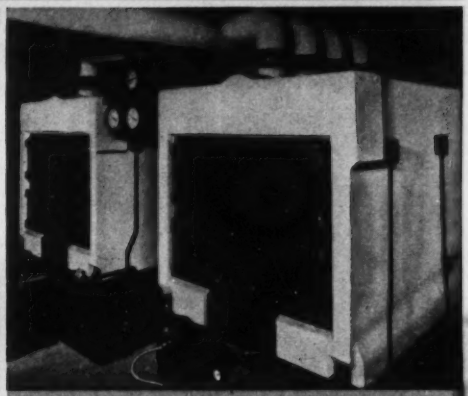
WRITE NOW for free sample of MYSTIK Self-Stik DRI-PIPE Insulation
to Mystik Adhesive Products, 2653 N. Kildare, Chicago 39, Ill.

MYSTIK CLOTH TAPES • MYSTIK PAPER MASKING TAPES • MYSTIK SPRA-MASK • MYSTIK PROTECTO-MASK • MYSTIK SAND-BLAST

AMERICAN-Standard

First in heating...first in plumbing

Sixth and Denny Branch of Seattle-First National Bank. Architects John W. Maloney, A.I.A.; Mechanical Engineer: DeWitt C. Griffin & Associates; Mechanical Contractor: Eastman Plumbing & Heating Co.; General Contractor: General Construction Co. All are Seattle firms.



A battery of two or more Redflash Boilers provides a heating plant of extreme flexibility. In cold weather the entire battery will team up to take care of the load. On mild days the fluctuating demand for heat can be efficiently handled by one of the boilers, thus effecting desirable economies in fuel.

Seattle's Most Modern Bank installs Redflash Boilers

Newest branch is fifth in large state-wide system to be heated by AMERICAN-Standard equipment

● One of the nation's fastest growing banks is the Seattle-First National. And it is one of the most progressive. Operating a state-wide system of branch offices, this great institution now ranks 24th in deposits among all banks of the country.

The attractive building shown above is the fiftieth and newest branch to be opened. Known as the Sixth and Denny Branch and located in the heart of Seattle's northern downtown business district, this modern banking building incorporates many unique banking facilities, including drive-in banking and a large parking area.

Another feature which reflects this important bank's sincere interest in the health and comfort of its customers . . . and its own personnel, is the installation of two American-Standard Redflash Boilers to insure dependable and efficient heat and operating economy. Redflash Boilers have also been installed in four other recently opened branches.

Redflash boilers provide economical heating for your commercial jobs!

Expertly engineered and sturdily constructed, the Redflash Boiler can be installed singly or in battery to provide an abundance of heat for large residences or commercial buildings of practically any size. Its scientifically proportioned combustion chamber, direct heating surface, and long flue travel for hot gases assure highest heat output with the least fuel. The Redflash Boiler and other large fired heating units in the American-Standard line are sold through selected wholesale distributors to heating and plumbing contractors.

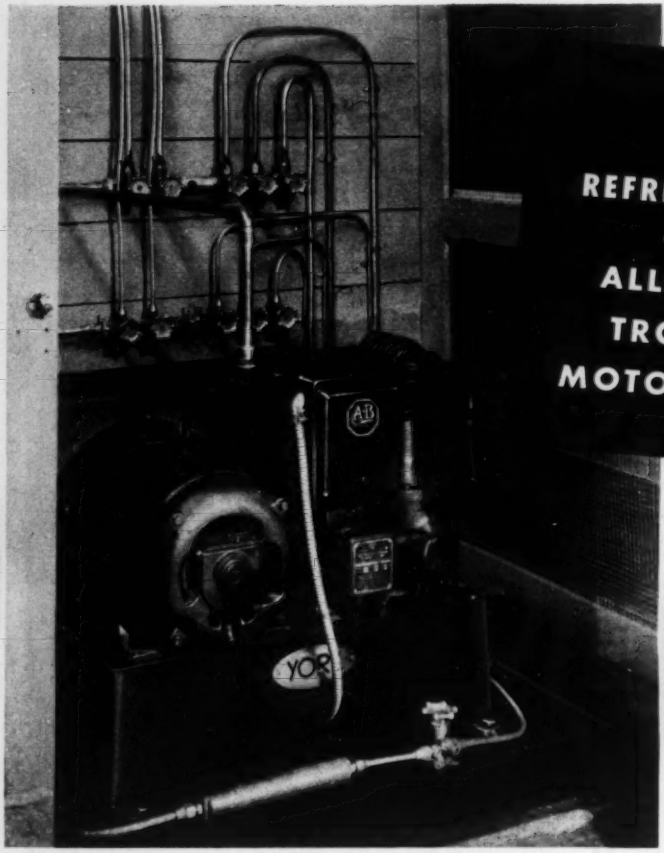
Easy to Install...

Redflash Boilers are shipped in sections, so that even the largest size is easily moved through a door or elevator hatch. Can be assembled quickly without tearing down walls or shifting heavy equipment.

American Radiator & Standard Sanitary Corporation, P. O. Box 1226, Pittsburgh 30, Pa.

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON



A York Compressor equipped with an Allen-Bradley Bulletin 709 Automatic Starter installed in an Atlantic and Pacific Store in Boston.

Why are Allen-Bradley starters so popular for refrigeration and air-conditioning service? . . . Because they are trouble free. Only ONE moving part. No pivots, pins, or bearings to corrode or stick . . . no jumpers to break. You install them . . . and forget them!

No contact maintenance . . . Allen-Bradley patented silver alloy contacts never need cleaning, filing, or dressing.

Dependable overload relays . . . Allen-Bradley thermal relays are accurate and always dependable . . . even after long service.

The Allen-Bradley trade-mark stands for millions of trouble free operations.

Allen-Bradley Co., 1335 S. Second St., Milwaukee 4, Wis.

A-B Bulletin 709 Solenoid Starter

Size 1 starter with cover removed. Dependable relays provide accurate overload protection. Note white interiors and ample space for ease of wiring.

A-B Special Refrigeration Control Unit

Consists of Bulletin 709 solenoid starter, Bulletin 836 high pressure cutout, Bulletin 837 thermostat with adjustable knob, and Bulletin 600 manual switch.

ALLEN-BRADLEY SOLENOID MOTOR CONTROLS

SUPER-SILVERTOPS

FOR

THEMSELVES!

● Super-Silvertop Steam Traps pay for themselves because they are installed and serviced so much faster and easier than any other trap. Look how the Super-Silvertop design provides for 3 pipe connections in the head so that you can easily install the trap as an elbow or straight-in-line. This feature, standard on all Super-Silvertops, eliminates "jungle" piping that accompanies traps with only 2 pipe connections . . . actually saves up to 7 fittings plus 50 minutes installation time over conventional traps.

Good preventive maintenance calls for periodic steam trap inspection. To inspect any Super-Silvertop, you simply loosen and remove the body . . . no pipe fittings to disconnect before you can get to the inside of the trap. These two features, plus the patented guided bucket that eliminates sloppy bucket action and damage, are the reasons why more and more plants are standardizing on Super-Silvertops. Buy the trap that pays for itself. See your local Super-Silvertop distributor about selecting the right trap for your requirements.

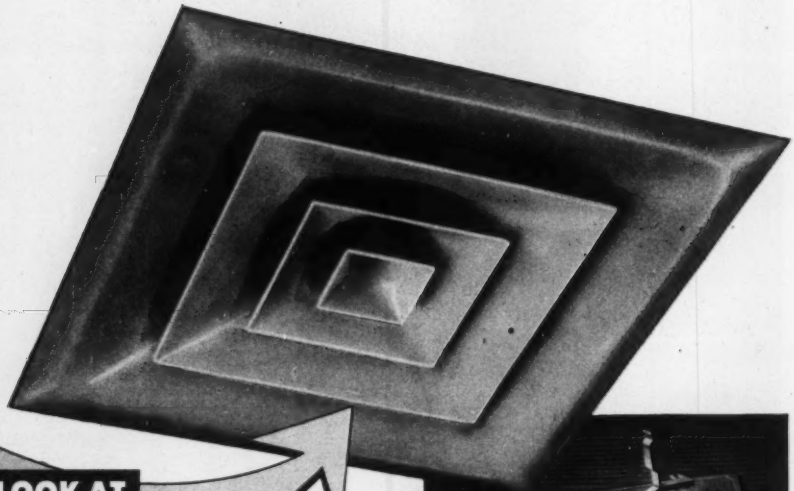
FREE THIS FAMOUS SUPER-SILVERTOP BOOK *is yours for the asking. Explains how to select the right steam trap for any installation. Many useful maintenance helps. Write for your copy of "Solving Steam Trap Problems" today.*

THE V. D. ANDERSON COMPANY

1949 WEST 96TH STREET • CLEVELAND 2, OHIO

In Canada: Bawden Industries, Ltd., Toronto

SUPER-SILVERTOP STEAM TRAPS



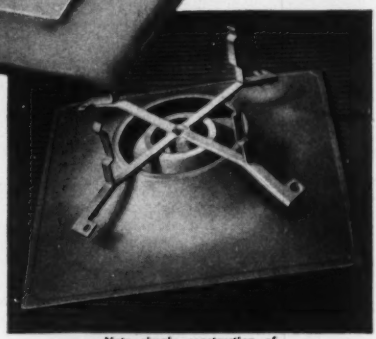
easy TO LOOK AT

easy TO INSTALL

SQUARE

Anemostat Air Diffusers

A glance at either the Type E Anemostat Air Diffuser which fits perfectly into acoustic tile ceiling construction, or the Type E-1 which is flanged for standard ceiling installations and you'll agree that these diffusers lead the beauty parade. Moreover, these outlets give you not only the benefits of Anemostat's superior performance but they are a *snap* to install because the inner assembly does just that—it *snaps* into place. No special tools are required and access to the furred space above the ceiling is unnecessary. Just *snap* out the inner assembly and you have the full neck opening to work in. Then fasten the outer member to the duct, *snap* on the equalizing deflector, *snap* the unit together and you're done. Anemostat Square Air Diffusers are easy to look at, easy to assemble and easy to install. They are easy to obtain as well. We have Anemostat Square Air Diffusers "on the shelf" in sizes to meet every need.



Note simple construction of inner assembly

Snap the Equalizing Deflector on the spider

Just snap the inner assembly into the outer member

AC-1271

ANEMOSTAT®

DRAFTLESS *Aspirating* AIR DIFFUSERS

ANEMOSTAT CORPORATION OF AMERICA

10 EAST 39th STREET, NEW YORK 16, N. Y.

REPRESENTATIVES IN PRINCIPAL CITIES

"No air conditioning system is better than its air distribution"

It's easier to maintain ARMSTRONG TRAPS

THEY SELDOM NEED ATTENTION

GOOD preventive maintenance of course calls for periodic steam trap inspection. To look inside an Armstrong trap you simply remove the cap and lift out the entire mechanism, which is connected to it. The body full of boiling water remains in the line and need not be handled.

Only rarely does inspection reveal the need for cleaning or repairing an Armstrong trap. The swirling action of the condensate during discharge continuously scrubs the trap clean. The hardened chrome steel valve and seat stay steam-tight for a long, long time without attention. There is no wire drawing. The leverage system is almost completely friction-free, will operate hundreds of thousands of times without wearing out.

For trouble-free trap performance there is nothing to compare with an Armstrong. Your local Armstrong representative can help you select the right size traps for your requirements. Call him.

ARMSTRONG MACHINE WORKS
874 Maple Street • Three Rivers, Michigan

30% LESS MAINTENANCE

Armstrong traps on low pressure heating systems require far less maintenance than previous traps...John Deere Harvester Works, East Moline, Illinois.

4 YEARS — NO REPAIRS

"4 to 5 years service without replacement parts is average on traps draining driers. Some traps in service with no parts for 7 or 8 years — and one for 15 years!"—Weymouth Art Leather Co., South Braintree, Massachusetts.

THE ARMSTRONG SERVICE GUIDE explains trap maintenance and repair, contains useful trouble shooting tips. Send for your free copy.

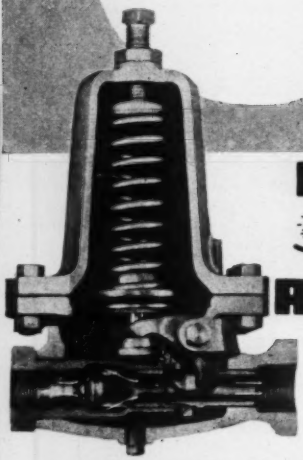
SEE OUR CATALOG IN SWEET'S or CEC

ARMSTRONG STEAM TRAPS

EXTRA LARGE CAPACITY
TIGHT CLOSING CHARACTERISTICS
CLOSE DELIVERY PRESSURE CONTROL
WIDE RANGE OF ADJUSTMENT

Combine to Give You..

SMOOTH OPERATION
SPEEDIER PRODUCTION
NO SPOILAGE



CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVES

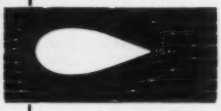
The "1000" valve is single seated and its valve makes line contact with its seat ring which accounts for its tight closing characteristics. The unusually long diaphragm spring insures sensitive pressure control.

Steam, water, air, oil, etc. flow through this valve in a straight line—nothing is in the path of flow to cause turbulence — therefore, peak flow is never a problem.

TURBULENCE LIKE THIS *Eliminated*

The inner valve is streamlined — no back eddies to hinder flow — valuable when you want all possible fluid to go through the valve to meet peak demand.

YOU GET THIS *Streamlined* PATTERN



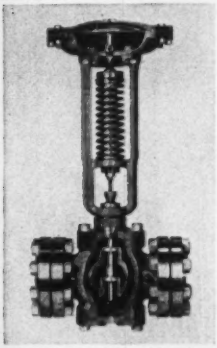
Turbulence eliminated by venturi approach to the valve seat — it means better flow. The inlet pressure is confined to a small cylindrical chamber, the same being advantageous for high pressures.

Write for bulletin "1000" that fully explains the cost-saving benefits that begin with installation and last for years.

CASH STANDARD CONTROLS.. VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

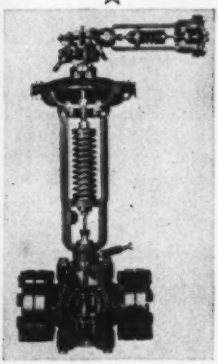
OTHER VALVES *from the* CASH STANDARD LINE



Cash Standard Type 34 Pressure Reducing Valve. For practically all fluids. Has roller bearing, also roller guides that kill side strains and stop packing trouble —no lost motion.

Sizes: ½" to 12" inclusive. Highest initial pressure 800 lbs.; reduced pressure vacuum to 150 lbs. Bodies: iron, bronze, steel. Trim: iron, bronze, stainless steel. Ends: screwed, flanged, ammonia type, welding type. Bulletin 968.

☆



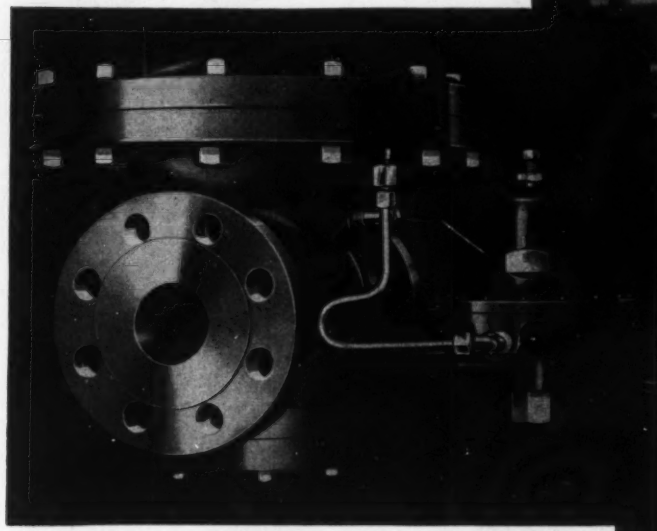
Cash Standard Type 30-AP Valve gives precise control of fluid pressures, through a pilot connected to the pressure under control. For steam, water, air, and most fluids.

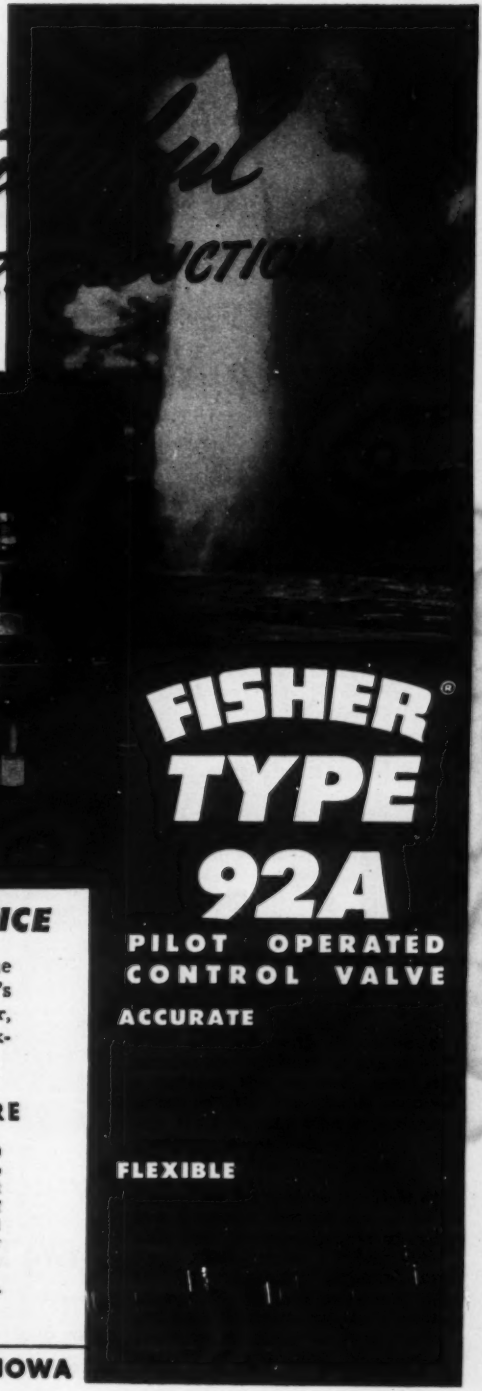
Can be a pressure reducing valve or a back pressure valve depending on the way the control lines are connected. Pressures up to 600 lbs. Sizes ½" to 12" screwed; 1" to 12" flanged ends; wide variety of metals.

☆

THE *Old Fa[illegible]*

OF STEAM PRESSUR[illegible]JCTIO[illegible]





FISHER® TYPE 92A

PILOT OPERATED CONTROL VALVE

ACCURATE

FLEXIBLE

BUILT FOR UNFAILING SERVICE

Power engineers everywhere have ok'd the **Fisher Type 92A** for steam pressure control! It's an accurate, compact, flexible, sturdy controller, designed, built and proved to meet the **most exacting requirements** for steam service.

SINGLE SEATED • TIGHT CLOSURE

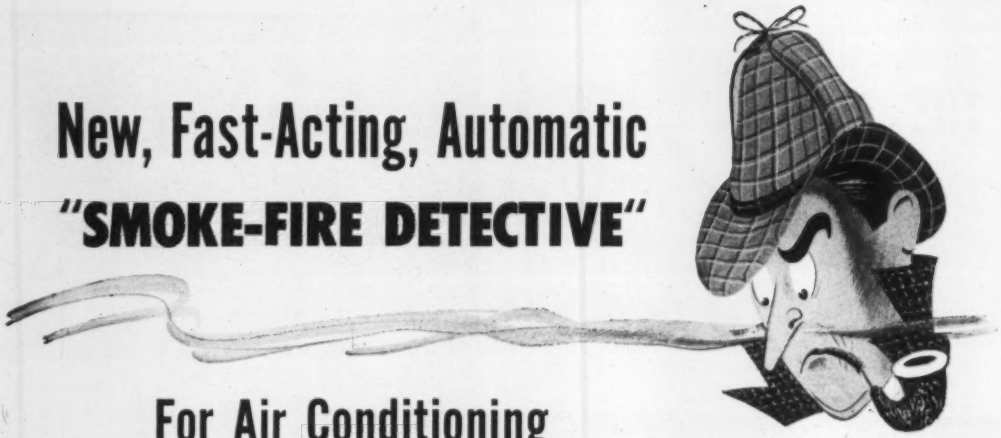
The single seated hardened stainless steel construction assures tight closure and prevents excessive pressure build-up. Sizes: ½" to 2" screwed; 1" to 6" flanged. Reduced pressure ranges 3 to 200 PSI. Inlet pressure up to 250 PSI at 450° F. Pilot inner valve and seat of hardened stainless steel to give long life under wire drawing conditions.

Fisher Bulletin C-3 gives full details. Write for your copy today.

FISHER GOVERNOR CO.

MARSHALLTOWN, IOWA

New, Fast-Acting, Automatic "SMOKE-FIRE DETECTIVE"

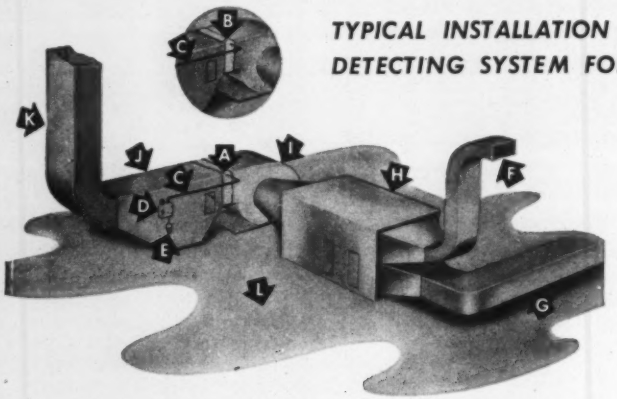


For Air Conditioning

Smoke in your air conditioning spreads fast . . . causes panic, spoilage and needless expense . . . now all can be avoided by installing a modern, fully approved C-O-TWO Automatic Smoke Detecting System.

Smoke, smoldering and fire are spotted in the incipient stage anywhere throughout the air conditioning ducts, as well as via the return air from air conditioned spaces. Four types of smoke detectors and several different installation arrangements are available to fit your particular needs . . . for small air conditioning units, for large air conditioning systems, and whether with or without electrostatic precipitators. All C-O-TWO Automatic Smoke Detecting Systems function by drawing continuous air samples through simple piping to a smoke detector. The first trace of smoke sets off an alarm, based on an exclusive operating principle . . . no chance of smoke spreading . . . the air conditioning instantly shuts down, dampers close and fire extinguishing systems actuate.

Act now for complete free information and descriptive literature on this newest contribution to modern fire fighting. An expert C-O-TWO Fire Protection Engineer will be glad to help you in planning economical, fully approved fire protection facilities without obligation. (Special assistance rendered to qualified air conditioning contractors.)



TYPICAL INSTALLATION C-O-TWO AUTOMATIC SMOKE DETECTING SYSTEM FOR AIR CONDITIONING DUCTS

- **A** perforated smoke accumulating pipe
- **B** smoke accumulating pitot tube (alternate)
- **C** pipe line for carrying continuous air samples to smoke detector
- **D** smoke detector
- **E** audible alarm
- **F** fresh air intake and duct
- **G** return air duct
- **H** air cleaning unit
- **I** air fan
- **J** air cooling and heating unit
- **K** supply air duct
- **L** floor level

C-O-TWO

C-O-TWO FIRE EQUIPMENT COMPANY
NEWARK 1 • NEW JERSEY
Sales and Service in the Principal Cities of United States and Canada
Affiliated with Pyrene Manufacturing Company

MANUFACTURERS OF APPROVED FIRE PROTECTION EQUIPMENT
Squeez-Grip Carbon Dioxide Type Fire Extinguishers • Dry Chemical Type Fire Extinguishers • Built-In Smoke and Heat Fire Detecting Systems
Built-In High Pressure and Low Pressure Carbon Dioxide Type Fire Extinguishing Systems

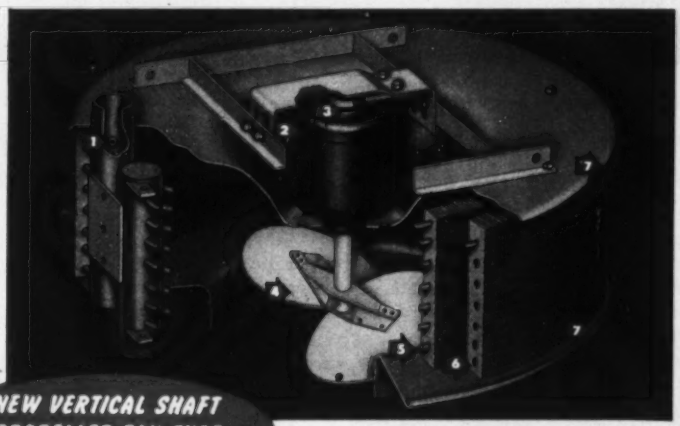
Heat for wherever it's Cold

THE MOST COMPLETE LINE OF UNIT HEATERS FOR INDUSTRIAL, INSTITUTIONAL AND COMMERCIAL BUILDINGS

Herman Nelson makes a unit heater for every heating purpose, and each is designed to provide peak performance at lowest operating cost. Constant research by Herman Nelson design engineers maintains a standard of quality that has been recognized throughout the years by both suppliers and users.

The functional design and construction of all Herman Nelson Unit Heaters insures easy installation and minimum maintenance. All units operate on either steam or hot water. All units are modernly styled and attractively finished.

Durable, rugged, long-lasting materials and superior craftsmanship in construction assure unit heaters that are second to none – units that will give years of efficient, trouble-free performance for any space heating requirement.



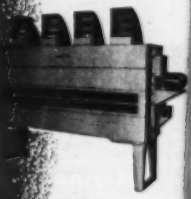
NEW VERTICAL SHAFT PROPELLER-FAN TYPE UNIT HEATER

Comes in 3 models and 30 sizes. Five types of diffusers available.

1. Orificed radiator tubes assure proper steam distribution and eliminate air binding – no cold spots.
2. Motor has been especially selected for unit heater application.
3. Motor manufacturer's method of holding the motor cushion hub rings avoids undue pressure and distortion of the rubber. It also provides insulation of motor vibration between motor and cabinet.
4. Fan with wide face area of aerodynamic or streamline shape provides quieter operation.
5. Red brass tubing in radiator provides maximum heat transfer and resists corrosion.
6. Fins have holes for tubes, formed with flanged edges to provide permanent contact between tubes and fins and proper spacing between fins.
7. Attractive cabinet of heavy sheet steel finished in platinum green enamel.

Vertical shaft propeller-fan type unit heater – especially suited to buildings with high ceilings – up to 50 feet.

Horizontal shaft propeller-fan type unit heater – the most generally useful of all space heaters.



Centrifugal-fan type unit heater – for efficient heating of large industrial space.

De Luxe unit heater – the most versatile product of its type, suitable for stores, offices, churches, etc.

AAF herman nelson

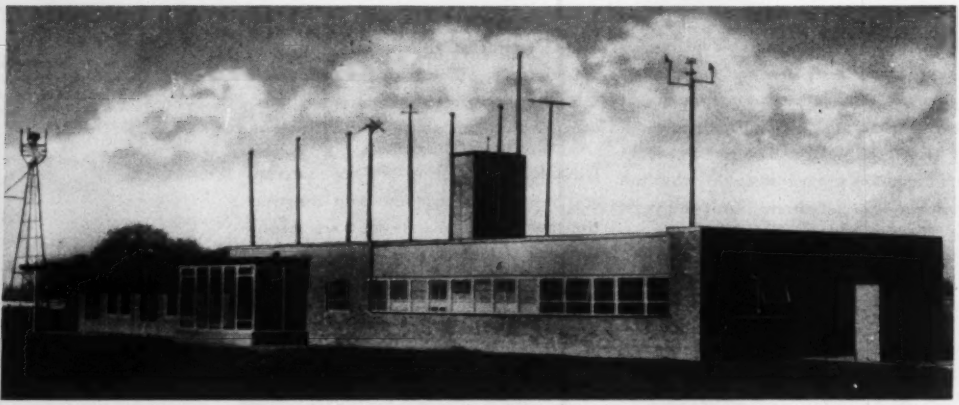
HERMAN NELSON

Division of AMERICAN AIR FILTER COMPANY, INC.

MOLINE, ILLINOIS

Write for free unit heater data book.

WARM AIR HEATED... by Campbell



Burlington, Iowa, Municipal Airport Terminal, heated by an oil-fired Campbell 8000 Heater. Carswell & Thornquist, Architects and Engineers, Burlington, Iowa

IDEAL FOR PUBLIC BUILDINGS

Warm air heating for large, multiple room structures is both practical and economical when you build your plans around a Campbell 8000 Warm Air Heater. Campbell Heaters are designed to fully utilize all the natural advantages of warm air heating; quick heat delivery, positive temperature and humidity control, ventilation, and easy adaptability for summer air conditioning. Easy to install — built to give years of satisfactory service. Write for complete information.

SPECIAL UNITS FOR DRYING & PROCESSING

We build direct oil and gas-fired units up to 14,000,000 BTUs.

CAMPBELL HEATING COMPANY

P. O. BOX 833 · DES MOINES 4, IOWA

wherever
PRODUCTS CAN BE
bettered
BY THEIR BEARINGS

All bearings are designed to eliminate costly friction . . . but only SEALMASTERS can offer the many *extra advantages* that SEALMASTERS' exclusive combination of features gives to your product.

SEALMASTER users report smoother machine operation—with reduced power consumption and minimum maintenance. The proved, all-around efficiency of SEALMASTER Ball Bearing Units is the best assurance of long life and dependable service under even the most difficult conditions.

Write for a copy of Catalog 845 . . . it tells the complete SEALMASTER story.

SEALMASTER
BALL BEARING
UNITS

1. PERMANENTLY SEALED
Felt-lined steel flinger, rotating in labyrinth, excludes dirt and retains proper amount of lubricant.

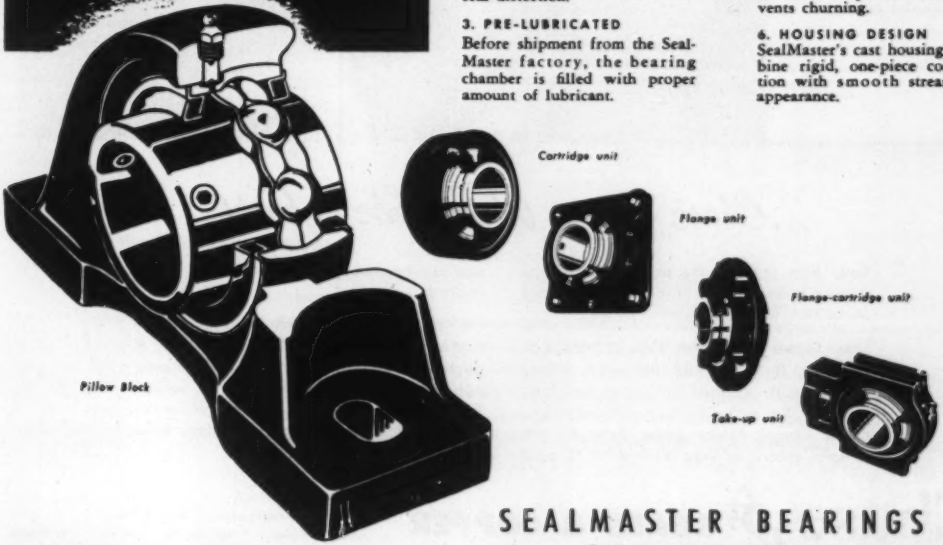
2. SELF-ALIGNING
Bearing unit, with seals independent of housing, can align itself in any direction without seal distortion.

3. PRE-LUBRICATED
Before shipment from the SealMaster factory, the bearing chamber is filled with proper amount of lubricant.

4. NO HOUSING WEAR
Patented locking pin and dimple prevent rotation of outer race in housing. This eliminates housing wear, permits shaft alignment and positions unit for relubrication.

5. FLOATING RETAINER
Ball retainer is designed to float on ground inner surface of outer race. Traps lubricant, prevents churning.

6. HOUSING DESIGN
SealMaster's cast housings combine rigid, one-piece construction with smooth streamlined appearance.



SEALMASTER BEARINGS
47 RIDGEWAY AVENUE, AURORA, ILLINOIS
A DIVISION OF STEPHENS-ADAMSON MFG. COMPANY

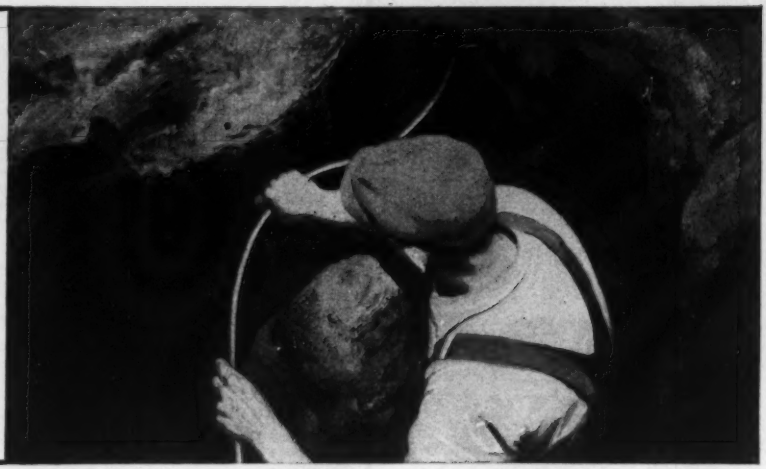
FACTORY REPRESENTATIVES AND DEALERS IN ALL PRINCIPAL CITIES

HIGH

For domestic hot and cold water lines you can still use copper — non-rusting, highly resistant to corrosion!

LOW

The use of copper for underground service lines—another place where you need this hardy metal—is not prohibited by government regulations!



...Chase Copper Water Tube is best!

Made from commercially pure copper, Chase Copper Water Tube is ideal for hot and cold water lines and underground piping.

Chase Copper Water Tube, Type L, hard temper, in 20 ft. lengths and solder-joint fittings are especially adapted for use in new construction. For replacing old rusted-out piping, Chase Copper Water Tube, Type K, soft temper, comes in long 40 and 60 ft. coils that can be snaked behind walls and under flooring.

For underground installations use Type K, soft temper, Chase Copper Water Tube. It is ductile; can be bent around obstructions; moves with the earth until the fill settles. Long lengths up to 100 ft. in coils reduce the number of flared fitting connections to a minimum.

Chase BRASS & COPPER

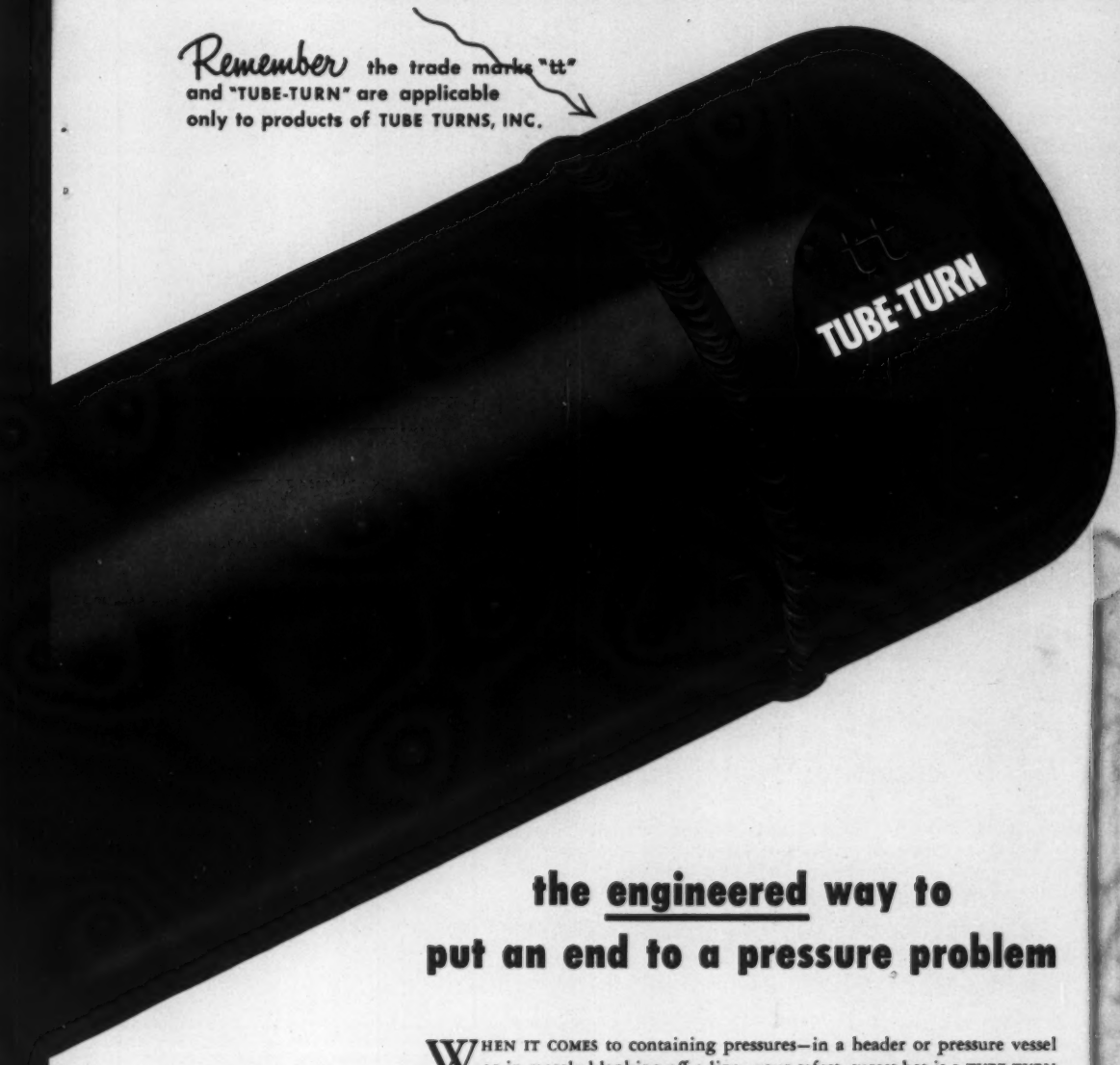
WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

CHASE 75th ANNIVERSARY 1876 1951

• *The Nation's Headquarters for Brass & Copper*

Albany†	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
Baltimore	Denver†	Milwaukee	Pittsburgh	Waterbury
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston†	Newark	Rochester†	(†sales office only)
Cincinnati	Indianapolis	New Orleans	St. Louis	

Remember the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.



the engineered way to put an end to a pressure problem

Write Dept. A-9 for free booklet giving Dimensional Data on types, sizes and materials of TUBE-TURN Welding Fittings and Flanges.

WHEN IT COMES to containing pressures—in a header or pressure vessel or in merely blanking off a line—your safest, surest bet is a TUBE-TURN Welding Cap. Formed to 2:1 semi-ellipsoidal contours, it represents the ideal pressure-resisting closure for a cylinder. No makeshift capping method can approach its bursting strength which is actually far greater than seamless tubing of like thickness and grade of steel.

Another important point: TUBE-TURN Welding Caps are manufactured to meet ASME Boiler Code requirements and the chemical-physical standards of ASTM specification A106 for Grade A and Grade B carbon steels.

For welding caps and for all TUBE-TURN Welding Fittings and Flanges, see your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

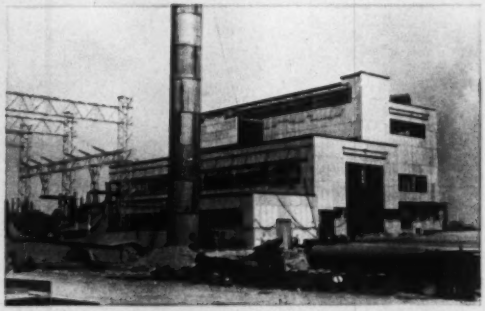
"Be sure you see the double tt

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles

TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO... A wholly owned subsidiary of TUBE TURNS, INC.

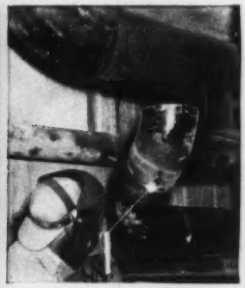
New Ford Power Plant features welded piping



Power station for Ford Motor Company's giant new engine plant and foundry, now being built in Cleveland; F. A. Fairbrother —Geo. H. Miehls, Architect and Engineer; Albert Kahn Associates, Consultants. Engine plant will be equipped with the last word in automatic machinery—to save production man-hours. The designers believe in saving maintenance man-hours too. Thus at the power plant, which will supply 360,000 pounds of 150-lb. steam per hour for heating and process, an all-welded piping system with TUBE-TURN Welding Fittings and Flanges was specified. Welded steam, air, and condensate lines are permanent and leakproof.

Here the 18" steam main from the power plant leads to a fabricated "Y" connection, then through tunnels to foundry and engine shop. One side is stepped down through a TUBE-TURN Welding Reducer to a 16" line; the other side through another TUBE-TURN Welding Reducer to a 12" line. Special "Y" connection was made by cutting and welding two 45° Welding Elbows, a job that calls for uniform wall thickness and concentricity throughout the fittings—a point of pride with TUBE TURNS, INC.

In engine shop, smaller lines designed to carry coolant oil to machine tools are also welded. Wide range of TUBE-TURN Welding Fittings and Flanges—including more than 4000 different items—simplifies installation job. Leak-proof piping will free maintenance personnel for other work.



Despite close quarters in tunnel, fabrication goes ahead swiftly. Welders and contractors like to use TUBE-TURN Welding Fittings because they know that dimensions are always accurate, thus line-up is easy. Welded lines can be fitted closely together, will make for a neat installation. With no flanges to work around, insulation can be applied easily.

TUBE TURNS, INC., Dept. A-9
224 East Broadway, Louisville 1, Kentucky

Your Name .....

Position .....

Company .....

Nature of Business .....

Address .....

City ..... *State* .....

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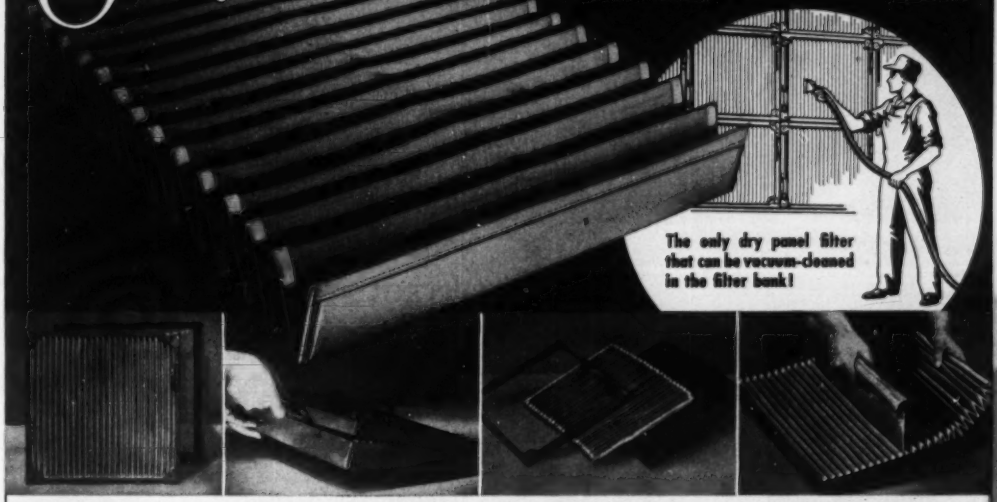
TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

UNSURPASSED IN EFFICIENCY · ECONOMY · VERSATILITY

Staynew DRY PANEL FILTERS

Feature Pre-formed, Wire-clad Inserts



Cell removed from frame by sturdy offset handles after releasing locking cams.

Removing pre-formed Insert is simple. Snap catches are released, cover lifted off, Insert lifted out.

Dis-assembled cell showing removable cover, Insert and box containing permanent fin support.

Insert easily slipped on permanent fin support by means of special Staynew Loading Knife.

. . . *pre-formed* so that Inserts can be slipped on or off the permanent fins in seconds! . . . *wire-clad* for complete protection of medium and maximum fire resistance! . . . *Class I Underwriters' Approval* in bonded glass!

FIN CONSTRUCTION provides the greatest possible filtering area in available space. Resistance in relation to dust load is less than in panel filters built on any other principle.

OPERATING ECONOMY is amazing. The most fragile medium can be cleaned repeatedly either by vacuum or fluid (dry-cleaning). Insert replacement cost is very low.

STAYNEW DRY PANEL FILTERS are *versatile* . . . utilizing any medium in sheet form that can be crimped. Stock media include wool felt, rayon-cotton-wool felt, bonded glass, and Feltex. The latter is a surprisingly low cost, highly efficient medium.

INSTALLATION can be in flat or V-banks, frames riveted but individual cells removable in a matter of seconds. All standard sizes are available in 2″, 4″ and 8″ depths.

FOR EVERY DRY PANEL NEED there is a Staynew model and medium for maximum efficiency at minimum cost.

WRITE FOR BULLETIN DPF

Representatives in Principal Cities

DOLLINGER CORPORATION

9 CENTRE PK., ROCHESTER 3, N. Y.

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

ONCE AGAIN, EXPERIENCE MAKES JANITROL FIRST CHOICE

Huntington Gardens in North Detroit comprises 60 buildings with 374 two bedroom units. Each apartment is individually heated with Janitrol Gravity Furnace. Planner and Builder: General Houses, Inc.; Heating: Richman Heating Co.

"I'VE USED HUNDREDS OF JANITROLS FOR MANY YEARS, THEY ARE SATISFACTORY IN EVERY WAY"

M. M. ROBINSON,
Pres. General Houses, Inc.

Each apartment unit has three levels; basement with Janitrol Furnace Installation; first floor, living room, kitchen and dinette; second floor, two bedrooms and bath.

367 Families IN HUNTINGTON GARDENS ENJOY CAREFREE Janitrol® GAS-HEATING

Janitrol 75,000 Btu/hr Gravity Furnace with Control cover removed. Average annual heating bill, paid by tenant—$72.

Over the years in the building and management of houses and apartments, General Houses, Inc. has had experience with many makes of heating equipment . . . the fact that they now standardize on Janitrol speaks for itself.

This is no isolated case, for in state after state wherever clean gas heat is available, you'll find Janitrol equipment, whether it's Gravity Furnaces, Winter Conditioners or Boilers, delivering dependable heating with economy of operation and a minimum of service.

For a single house, project or apartment housing, be sure to contact your local authorized Janitrol dealer. He can assure you of better heating at no extra cost.

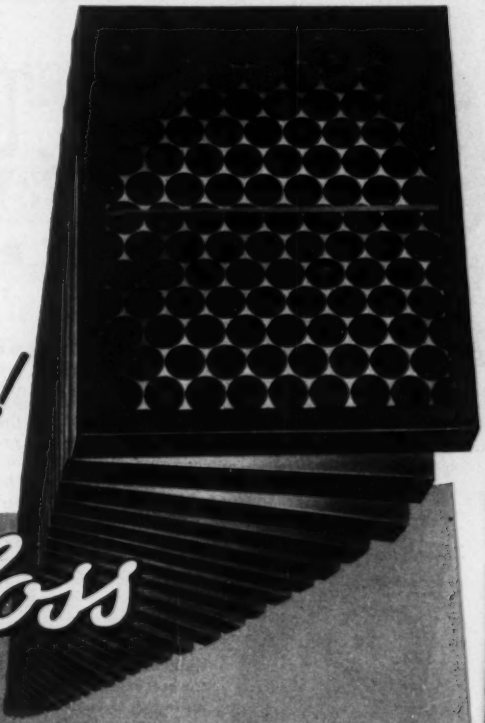
SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

The complete Janitrol line includes, Winter Conditioners, Gravity and Floor Furnaces, Attic Units, Unit Heaters, Boilers, Conversion Burners.

Get 'em!

Sell 'em!

Make More Money!



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AIR FILTERS

"FINEST ON THE MARKET"

HERE are the important things to bear in mind about GLASFLOSS Air Filters. First, they're available in the quantities you need and in all standard sizes. Second, they're easier to handle, sell fast and build repeat business. Third, there is a higher profit in the GLASFLOSS line—*you make more money.* The basis for these facts lies in superiority of GLASFLOSS itself. It's the long, fine glass fibres that so efficiently filter dust and provide greater circulation of clean air. There are GLASFLOSS Air Filters to fill every need of central heating, ventilating and air conditioning. Write today, for complete information.

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Glasfloss 155 EAST 44th STREET, NEW YORK 17, N. Y.

...Digging for facts

ON AUTOMATIC REGULATING VALVES?

YOU'LL FIND THESE KLIPFEL BULLETINS PRACTICAL, FACTUAL AND USEFUL!

Klipfel engineers have put a lot of experience and research into these bulletins to make them useful to you . . . the man who uses or specifies automatic regulating valves. Each bulletin covers such points as: the advantages and limitations of different valve constructions; selecting the proper type valve for given operating conditions; determining the most effective and economic size valve for the job.

In short, Klipfel engineers have prepared these bulletins to assist you in selecting the type and size valve best suited to your needs.

Write Dept. C-9 for any bulletins you wish. We'll gladly send them to you.

KLIPFEL REDUCING VALVES
for steam, air and water . . . in lever and weight, air loaded, pilot control and spring loaded types; descriptions, illustrations and complete selection data in Bulletin 148.

KLIPFEL FLOAT VALVES
Single and double seated types with direct action or pilot control for remote location. Types shown include quick-acting valves; all are available in angle and globe patterns. Bulletin 349.

KLIPFEL THERMOSTATIC VALVES
vapor pressure operated valves with spring or weight and lever loading. Valves are ball type, balanced cup and disc or balanced inner valves. Min. temp. 80°. Max. temp. 250°. Range limit of any instrument 40°. Full Data in Bulletin 449.

KLIPFEL BACK PRESSURE AND RELIEF VALVES
for control of air, steam and water pressures at the valve inlet in various types for practically any service. Bulletin 648 gives complete details including dimensions and capacities.

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DIVISION OF HAMILTON - THOMAS CORPORATION, HAMILTON, OHIO

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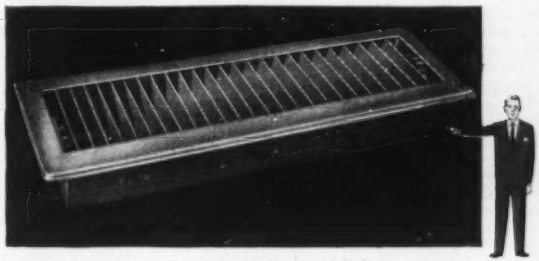
Standard's new, exclusive dialamatic control gives you POSITIVE HEAT CONTROL. The set screw arrangement means easy balancing, trouble-free operation!



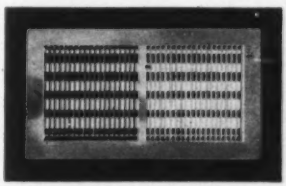
Duct opening	Overall of Louvre Box	Overall of Face	Open Area	Depth of Box
2¼" x 14"	2⅞" x 13¾"	3¾" x 15⅜"	80%	2⅛"

SPECIFICATIONS

The blades of model PH-142 are fabricated of 16 gauge steel, the blades are set in a fixed-fan angle degree for even deflection. The Frame is of one piece, 18 gauge steel construction. The Louvre box fabricated of 16 gauge steel. Packed one to a box, and 20 to a master carton. Comes handsomely finished in gleaming, durable metallic-lustre finish.

THE NEW, IMPROVED *multiple valve* REGISTER

Has Horizontal Multiple Valve Louvres, and 3/16" turned down edge for flush sidewall installation. The attached sponge rubber gaskets are an *extra* feature that prevents escape of air and chipping of wall surface. The Louvres are adjustable so that the flow of air may be directed either downward, straight forward, upward, or to complete shut-off.



MODEL NO. 331

Metallic Finish standard finish on this style

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Construction Goes Under CMP

All construction activity goes under the Controlled Materials Plan beginning with the fourth quarter of 1951. The NPA has issued this explanatory information in question and answer form

Why was a change made in construction controls by the new orders of the National Production Authority, which were announced August 3?

When NPA adopted the Controlled Materials Plan, or CMP, the 1st of July, it was necessary to key in all limitations on construction with the quantities of controlled materials (steel, copper and aluminum) that were available and were needed in construction. It is only by limiting the use of controlled materials in construction that there will be adequate quantities of steel, copper and aluminum for the defense and defense supporting programs as well as for the types and phases of construction that *must* take place. This new order provides for the availability and use of those materials in construction commencing with the fourth quarter of 1951 and succeeding quarters.

Can a general statement be given of what this order does and how it works?

Generally, there has been something of a relaxation of controls. It ties in the continuation and commencement of construction during the fourth quarter with the availability and use of the controlled materials. If construction can be commenced and finished without the use of steel, copper and aluminum, no control of any kind is imposed and no type of authorization is required. If the construction, depending upon its type, will require for its completion only certain small quantities of controlled materials as specified in the order, the owner or his representative, except in the instance of recreational, entertainment or amusement construction, is permitted to proceed, and by self-authorization he may procure his requirements of those specified limited quantities of controlled materials, and no form of application or authority concerning the construction is required. Where, to complete the construction, he shall require during the fourth quarter and subsequent calendar quarters more than the specified limited quantities of controlled materials for which he can self-authorize, then an authorized construction schedule and a related allotment of controlled materials must be applied for and received before any individual may commence his construction. If the construction has already started and controlled materials will be required during the fourth quarter of 1951 and subsequent calendar quarters, an authorization to continue the construction and a related allotment must be applied for and received by the owner or his representative if the quantities so needed are in excess of the limited quantities which he may procure by his self-authorization per calendar quarter. In addition, there is a prohibition on the use of copper and aluminum for decorative purposes in construction, and a prohibition against the use of aluminum for any construction other than industrial. However, that prohibition does not extend to the use of Class B products which are made from aluminum, such as aluminum screens, doors and so on. In addition, the order prohibits the use of copper to be fabricated, adapted or fitted on the site of the construction for certain specified purposes—such as cornices, downspouts and gutters.

GUIDE FOR SMALL USERS — Types of construction and quantities (pounds) of controlled materials for which the self-authorization procedure may be used

Type of construction	Carbon steel excluding structural steel	Structural steel	Alloy steel and stainless steel	Copper and copper-base alloys	Aluminum
Industrial plants, factories or facilities, per project, per calendar quarter	[1]	[1]	[1]	2,000	1,000
Residential structures (using steel pipe water distribution systems) containing one dwelling unit, per structure [2]	1,800	None	None	35	None
Residential structures (using copper pipe water distribution systems) containing one dwelling unit, per structure [2]	1,450	None	None	160	None
Residential structures (using steel pipe water distribution systems) containing two dwelling units, per structure [2]	3,500	None	None	65	None
Residential structures (using copper pipe water distribution systems) containing two dwelling units, per structure [2]	2,750	None	None	300	None
Residential structures (using steel pipe water distribution systems) containing three dwelling units, per structure [2]	5,100	None	None	100	None
Residential structures (using copper pipe water distribution systems) containing three dwelling units, per structure [2]	4,100	None	None	450	None
Residential structures (using steel pipe water distribution systems) containing four dwelling units, per structure [2]	6,500	None	None	125	None
Residential structures (using copper pipe water distribution systems) containing four dwelling units, per structure [2]	5,200	None	None	575	None
All other types of buildings, structures, or projects, except those listed in Table I of NPA Order M-4A and multi-unit residential structures, per project, per calendar quarter	[3]	[3]	None	200	None
Buildings, structures, or projects of the types listed in Table I of NPA Order M-4A	None	None	None	None	None
Multi-unit residential structures	None	None	None	None	None

[1] 25 tons of carbon and alloy steel including structural steel (not to include more than 2½ tons of alloy steel and no stainless steel).
[2] Only one-half the quantities permitted under the self-authorization procedure may be used for an addition, extension, or alteration to or of an existing residential structure other than a multi-unit residential structure.
[3] 2 tons of carbon steel, including structural steel.

It has been indicated that there is a different situation for recreational, entertainment or amusement construction. What is the rule there?

If an individual wishes to build a recreational, entertainment or amusement project of any type listed in the order, he may do so without getting an authorization or an allotment of controlled materials *if* he will use in the completion of the construction of such a project (if he can find it) not more than 2 tons of carbon steel, 200 lb of copper, and no aluminum, alloy steel or stainless steel. Such an individual will not be granted an allotment of controlled materials unless he can prove a hardship or unless the construction of such a type is required in connection with the defense effort. Such an individual *cannot* self-authorize his procurement of any controlled materials for that type of construction.

What is the situation about a man who wishes to build a store, a warehouse or an office building? What does he do?

If, for the completion of his project, such an individual will not, in any quarter, need more than 2 tons of steel, and 200 lb of copper, (and no aluminum), he may go ahead with his construction and procure those quantities by his own self-authorization. He requires no authoriza-

The self-authorization procedure means that the contractor places on his delivery order the certification, "Certified under CMP Regulation No. 6," together with one of the following allotment symbols, depending upon the type of construction project involved:

U-6 for industrial plants, factories or facilities.

U-7 for residential structures other than apartment buildings.

U-8 for all other types of buildings, structures or projects except for apartment buildings and recreational facilities.

tion from NPA or anyone else. However, if, in any quarter, he requires more than those quantities which have been specified, he must file an application on NPA CMP Form 4C and make an application for an authorized construction schedule and an allotment of the quantities of materials which he needs for his construction.

How about a man who wishes to build an industrial building or factory? What is the rule concerning him?

If such a man will not use in his construction more than 25 tons of steel, of specified types, 2000 lb of copper, and 1000 lb of aluminum during a quarter, he may proceed with his construction and by self-authorization, procure up to those specified quantities of controlled materials. If he needs in his construction, in any quarter, more than those quantities of materials, he must file an application on CMP Form 4C and receive an authorized construction schedule and a related allotment.

What is the story about housing construction?

Housing is a slightly different situation. A distinction is made between 1-, 2-, 3-, and 4-family houses and the so-called multiple-unit housing, which is designed for more than four families. For the commencement of the construction of a multiple-unit housing project, one must file a 4C application and obtain an authorized construction schedule and a related allotment before he can commence. In 1-, 2-, 3-, and 4-family houses, an individual may build and self-authorize his procurement of controlled materials, without any other action, where his use of controlled materials in that house will not exceed certain specified quantities. For a 1-family house he may self-authorize for 1800 lb of steel, and 35 lb of copper, if he is to have steel piping in the house. However, if he is to have copper piping in the house, the quantities for which he may self-authorize are 1450 lb of steel, and 160 lb of copper. The quantities provided for in 2-, 3-, and 4-unit houses are varying, but are substantially in the same proportion. If the use of controlled materials in any such residential construction will exceed those specified quantities, the owner or his representative must file a Form 4C and ask for an authorized construction schedule and a related allotment of controlled materials. When a multi-unit residential structure has been commenced prior to October 1, 1951, its construction may be continued without an authorization if, for the completion of such a building, not more than certain specified quantities of controlled materials will be required. If greater quantities are required, an application for an authorization must be filed.

How about other types of construction which are underway and one needs these controlled materials in the fourth quarter and other subsequent quarters? What does one do?

He is in exactly the same situation as the man who is going to commence construction. He may self-authorize procurement of those limited quantities of controlled materials, depending upon the nature of the structure. If he needs more than those limited quantities in any quarter, he must file an application on Form 4C and receive an authorization to continue his construction and an allotment for the quantities in excess of those for which he can self-authorize. If he is not granted an authorization to continue and a related allotment for that quarter, he cannot continue with his construction during that quarter, for he cannot procure those materials from any other source.

Where do people file these various applications and secure authorized construction schedules and related allotments?

Examination of the new order will show that NPA has delegated to certain agencies of the government responsibilities for construction in their various fields of activities. For example, school and educational and hospital construction is under the control of the Federal Security Agency, and all applications should be filed with that agency, and that agency will be able to grant a construction schedule and a related allotment for that type of construction up to the extent of the quantity of controlled materials which have been assigned to that agency for that purpose. All housing construction goes to the appropriate field or Washington office of the housing authorities, as is indicated in the schedule to the order. Veterans Administration construction goes to the VA, and so on, as it is specifically set forth in the order. General commercial construction—including stores, office buildings, warehouses and all other types of construction which have not been delegated to other agencies—goes to the Facilities Bureau of NPA, Washington, D. C. The applications in that field will be processed there, and authorized construction schedules and related allotments which are to be issued will be made by NPA.

What are the prospects for new construction in the fourth quarter of 1951?

The needs of the military and the various demands of the defense-supporting programs are so exceedingly great that the quantities of controlled materials, especially structural steel, are greatly limited. Very little if any new construction in the commercial field can expect to receive allotments of controlled materials in the fourth quarter. It is not certain that there will be adequate quantities of controlled materials, for delivery in the fourth quarter, to take care of construction which has already commenced, although it is hoped that there will be.

Is it anticipated that the situation will be better during 1952?

It is hoped that the situation will improve, but frankly, much change is not expected until after the first quarter of 1952.

What forms are used in filing applications for construction?

Form 4C will be filed on all general types of construction except where the order specifically makes other provisions, which are very few instances. If an individual wishes to build the type of construction classed as recreational, entertainment or amusement and requests an authorized construction schedule and a related allotment for such construction, on the ground of hardship or on the ground that the prohibition of such construction does not further the defense effort, he files NPA Form 24A and also Form 4C. If an individual wishes to make application for an adjustment or exception from the prohibition on the use of copper and aluminum, he will also file on Form 24A. The order presently reads [August 3] that all such applications requesting permission to use copper and aluminum in construction must be filed with the National Production Authority. However, an amendment will be issued to provide that such an application will be filed with the appropriate agency having responsibility for that particular type of construction—such, as in housing, to the Housing and Home Finance Agency, in Washington.

Where does an individual get the necessary forms?

The forms may be procured at any regional or district office of the Department of Commerce.

The following NPA regulations directly affect construction:

1) Order M-4A has replaced M-4 as the basic construction order.

2) CMP Regulation 6 explains the method of acquiring an authorized construction schedule and an allotment of controlled materials.

3) Direction 1 to CMP Regulation 6 explains how self-authorization for small amounts of materials works.

4) NPA Order M-74 restricts the use of copper in the manufacture of certain items for construction purposes.

5) NPA order M-50 concerns construction of electric power facilities.

6) NPA order M-46B concerns construction of petroleum facilities.

7) NPA order M-77 concerns the construction of communications facilities.

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Cuts fuel costs up to 40%

Norman F. Beatty Memorial Hospital, Westville, Ind. Architect: Boyd E. Phelps, Inc., Michigan City, Ind. Heating Contractor: Robert Gordon Co., Chicago, Ill.

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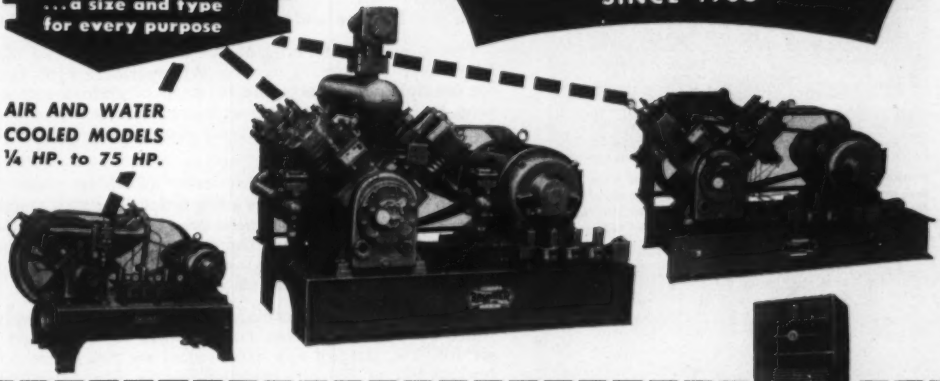
AIR AND WATER COOLED MODELS ¼ HP. to 75 HP.



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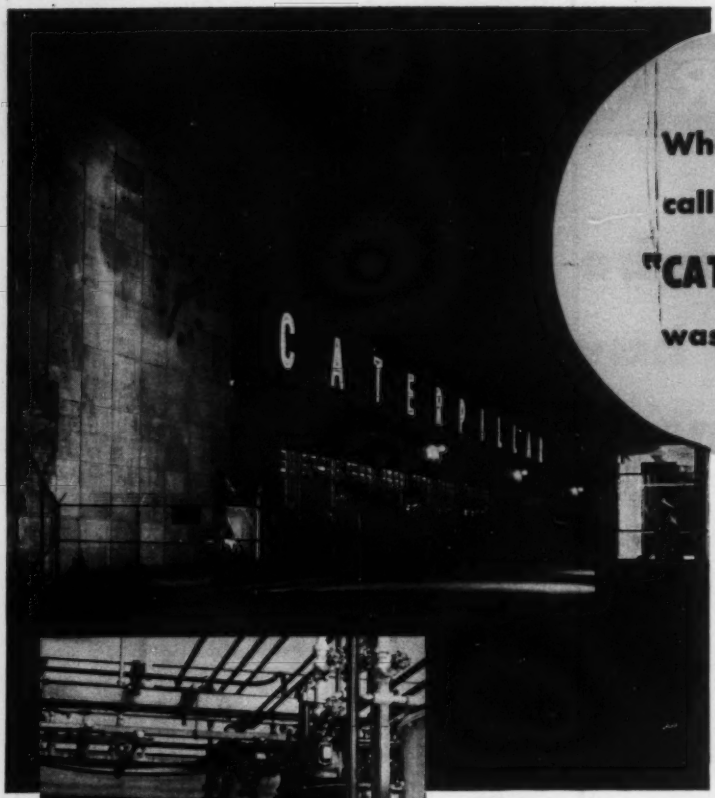
Self Contained Units in 4 sizes: 3-5-7½ and 10 HP.
Remote Installation Types from 3 to 75 HP.



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Another of America's vital plants equipped for lasting efficiency with

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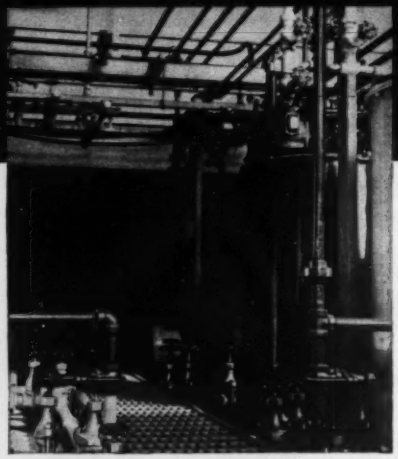

Among the thousands of Jenkins Valves on plant pipelines are these, where the identifying "highway yellow" paint for "Caterpillar" machines is prepared. Over 300 valves are used for flow control in each of several paint mixing units.

They're working around the clock these days at Caterpillar Tractor Co., Peoria, Ill.—one of the largest producers of earth-moving equipment and diesel engines. The big yellow "Caterpillar" machines are urgently needed—both for Defense and for essential civilian construction.

Future-minded planning of this modern industrial plant helps keep production moving. All operating equipment, for example, was selected on the basis of performance and long service life. The engine factory (above), like every building of Caterpillar Tractor Co., is equipped with Jenkins Valves.

Today, Jenkins is bending every effort to meet the Nation's need for valves. It's a big order. The men responsible for the defense production program know that valves are vital to plants readying the country for any emergency. And leading architects, engineers, and contractors rely on Jenkins for peak operating efficiency and economy.

For they know Jenkins builds *extra* endurance into valves—proved by low upkeep cost records in every type of service. Yet, despite this extra value, *you pay no more* for Jenkins Valves. For new installations, for all replacements, let the Jenkins Diamond be *your* guide to lasting valve economy. Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal.

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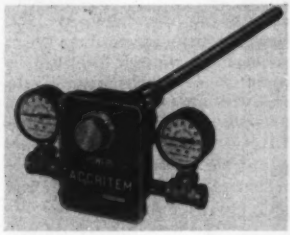
Sold through leading Industrial Distributors everywhere.

EQUIPMENT DEVELOPMENTS...

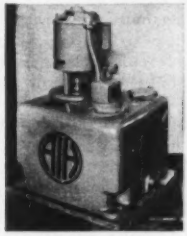
For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1951 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk, equipment and manufacturer not listed.

Temperature Regulator

HPAC 1—The improved, expansion type "Accritem" regulator, used to maintain liquids or air at desired temperatures by controlling pneumatic or water operated diaphragm valves or dampers, is offered by The Powers Regulator Co., 3501 Oakton St., Skokie, Ill. The regulator can be used with instantaneous water heaters, heat exchangers, large capacity water storage heaters, jacket water for air compressors, and in similar applications. Temperature ranges are 50 to 250 F (standard dial calibration) and 150 to 350 F. The sensitivity is adjustable between the limits of ¼ and 2¼ lb per 1 degree change. The regulator requires water or compressed air at 15 to 20 lb pressure. It is mounted with the thermostatic bulb at the point where temperature is to be controlled.



Regulator

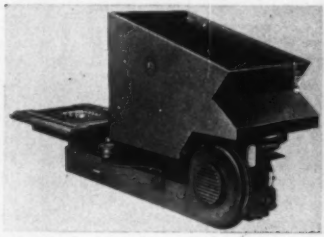

Condensate Return

Condensate Return Unit

HPAC 2—The new type SM-S "Spacemiser" cast iron condensate return unit, which can be completely buried in concrete, is now offered by American Hydrovac, Inc., 290 Scholes St., Brooklyn 6, N.Y. Requiring 16 in. x 16 in. of floor space, it is rated at 500 to 8000 sq ft EDR. Pump capacity is 14 gpm and receiver capacity is 11 gal. The ¼ hp motor, which has overload protection, operates on a single phase, 60 cycle current (115 or 230 volts) and at 3450 rpm. The pump is the bronze fitted, centrifugal, submerged design type with enclosed bronze impeller.

Hopper Model Stoker

HPAC 3—The "Deluxe Commercial" hopper model stokers of Iron Fireman Mfg. Co., 3170 W. 106th St., Cleveland, have been refined to permit easier filling of hoppers and to avoid interference with boiler flue cleaning doors. The hoppers are shorter in height and are now fully open and sloping on the top. They are available in two sizes designed for use in warm air, steam or hot water systems and industrial applications. In these units a metering type worm takes the coal from the hopper to the fire in an unpacked condition, allowing penetration of air through the fuel bed. The coal burns in an air cooled hearth from which fused residue is easily removed. The air required for combustion is supplied by a quiet fan and is automatically regulated to maintain a constant, predetermined air delivery.


Stoker

Ventilator

Ventilator for School Auditoriums

HPAC 4—A new "Volume Ventilator" is being offered by The Trane Co., La Crosse, Wis., to meet the high volume heating and ventilating requirements of school auditoriums and gymnasiums. Available in three models for wall, ceiling and floor installation, the ventilator can in-

FOR YOUR CONVENIENCE [9-51]

Heating, Piping & Air Conditioning
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each HPAC number in which you are interested)

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	101	102
103	104	105	106	107	108	109	110	111	112
113	114	115	116	117	118	119	120	121	122
123	124	125	126	127	128	129	130	131	132
133	134	135	136	137	138	139	140	141	142
143									

Name ..... Title .....

Company .....

Address .....

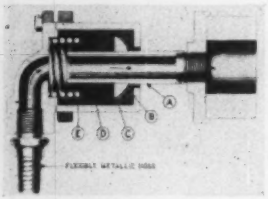
City ..... Zone ..... State .....

troduce, filter, heat and distribute up to 13,500 cfm of outside air, the manufacturer states. The company's nonfreeze steam heating coils are standard, and a variety of mixing boxes, wall intake boxes, etc. are offered as optional equipment.

Rotary Pressure Joint

HPAC 5—The self supporting type S joints of Johnson Corp., Three Rivers, Mich., are now available in heavy duty construction suitable for operating pressures up to 250 lb. This type of joint was developed for service on machines such as calenders, where considerable lateral movement of rolls is encountered. The joints are available in sizes of from ¾ to 3 in., and for through-flow (illustrated) or siphon pipe service.

The rotating member consists of a nipple (A) which is connected to the roll or drum. The nipple collar (C) rotates against a carbon graphite seal ring (B) which is forced against the collar when pressure fills the housing. A carbon graphite guide (D) supports the joint. The spring (E) is for initial seating only.



Above: Joint
Right: Control

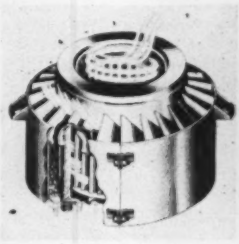
Liquid Level Control

HPAC 6—A new single stage liquid level control, model 26, designed for low pressures (up to 25 lb) has been developed by Magnetrol Inc., 2110 S. Marshall Blvd., Chicago 23. The same magnetic principle used in all the company's controls is employed in the new model. Operation involves two moving elements, the switch mechanism and the float assembly. Positive switching action is performed by a mercury type single pole, double throw switch which controls the fuel and the alarm circuits simultaneously. The control is 9¾ in. high and 4 in. in diameter. The conduit connection (for ½ in. conduit) rotates through 270 deg. If desired, a water gage set can be mounted to become an integral part of the control.

Vapor Purifier

HPAC 7*—The first in a new line of purifiers has been developed by V. D. Anderson Co., 1935 W. 96th St., Cleveland 2. This "Hi-ef" vapor purifier is of the internal type and is designed for used inside steam drums, flash tanks, evaporators, packed towers, etc. The units are guaranteed by the company to deliver vapor with 1.0 ppm or less of total solids. The new design eliminates the need for baffling in boilers and drums. The entrainment laden vapor enters the top of the purifier as far away from the liquid level as possible, passing downward in a rotary motion. Centrifugal force removes most of the entrainment, which is discharged below the liquid level.

The purifiers are available in a wide range of sizes in fabricated steel, stainless steels and other alloys. The 4 in. through 10 in. sizes are designed to pass through standard 10 in. x 16 in. and 11 in. x 15 in. elliptical manholes; the 12 in. through 36 in. sizes are for standard round manholes. Larger sizes of 39 in. to 72 in. also are furnished.



Purifier

Wrench

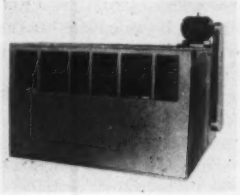
Open End Ratchet Wrench

HPAC 8**—The open end ratchet wrench of Tubing Appliance Co., 10321 Anza Ing., Los Angeles, is now commercially available. It has 64 socket sizes, and will do the work of open end, crescent, box, socket, ratchet and crowfoot wrenches, the manufacturer states. It can be used with a torque handle for torque rated fittings. The open end allows the wrench head and socket to fit on tubing and down on the fittings.

Multi-Zone Conditioners

HPAC 9—The new line of "Multi-Zone" air conditioning units of Marlo Coil Co., 6135 Manchester Ave., St. Louis 10, has been designed for those applications where one unit must serve two or more zones. Identified as Model CMZ, eight different sizes provide from 4.5 to 28.0 sq ft of coil face area, with a total air volume range of from 1500 to 17,000 cfm which can be divided into two to six zones.

Units are designed to provide ventilation, humidification, winter heating, air filtering, summer cooling, and dehumidifying. Each unit has its own thermostatically controlled dampers to modulate the flow of warm or cool air. The units can also be furnished with one coil only, to provide cooling or heating functions singly.



Above: Conditioner
Right: Motor

Vertical Motors

HPAC 10—Small and Medium Motor Div., General Electric Co., Schenectady, N.Y., has added new vertical, solid shaft capacitor motors in ratings of from ¾ to 5 hp to the company's line of "Tri-Clad" integral horsepower, single phase, capacitor motors. Principal application of the new motors is on jet pumps and other as-

How to Prevent Wet Concrete Floors

"High-heat capacity floors have a further undesirable feature in climates having abnormally high humidities, particularly in the summer. The concrete in contact with the ground is relatively cool, and frequently moisture condenses on the floor surface, damaging floor coverings.

"When the slab is insulated from the ground, its surface tends to follow air temperatures much more closely and is seldom below the temperature at which condensation begins to take place."

From *"Progressive Architecture"* research report: *"Insulation for Concrete Floor Slabs on Grade."*

Warmth in walls and ceilings flows to cold uninsulated floors, following nature's law that heat travels from warm to cold, in any direction, in conduction and radiation. The rate of radiation and absorption is over 90%. Furniture, even people, radiate heat to the colder floor, and also conduct heat down wherever they touch its colder surface.

The warmth absorbed by the floor flows down by conduction through solids to its colder under surface which radiates the heat wastefully to the ground at a rate exceeding 90%.

Multiple sheets of accordion aluminum *underneath* the floor reflect back 97% of radiation. The air spaces restrict heat flow by conduction to 5%. There is no such thing as convection downward. With practically no heat loss, the concrete *"tends to follow air temperatures"* and remains above dew-point.

Moreover, multiple accordion aluminum has zero vapor permeability. It remains permanently in place, is cheaply installed without the need of expensive support, and does not tear where stapled because it weighs but 1 oz. to the sq. ft. and is moisture-proof and non-condensation-forming.

TECHNIQUE FOR INSULATING CONCRETE FLOORS

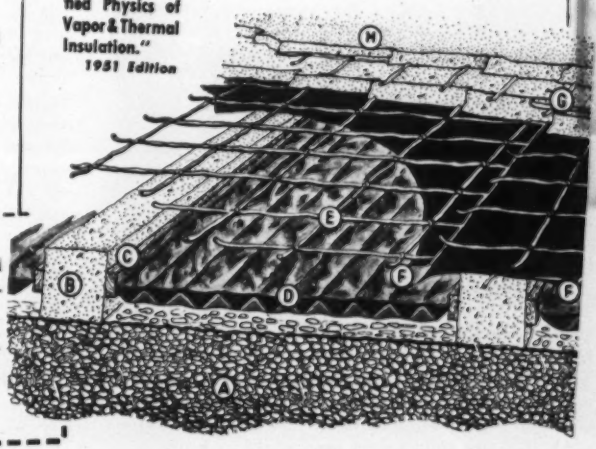
Installed over rolled gravel (A), for residences; over appropriate 4", 5", 6", etc. cement slab for factories, warehouses, hangars, etc.

(1) On 16" centers make appropriate forms for concrete joists (B), 3"x3", 4"x3", 4"x5" etc. **(2)** Pour concrete joists **(3)** After concrete sets semi-hard, **(4)** nail wood lattice or furring strips (C), **(5)** to sides of concrete joists and **(6)** staple Infra insulation (D) to them **(7)** with at least 1" space from top of concrete joist.

(8) Over concrete joists place asphalt-paper-backed welded wire mesh (E) (3"x3", or 3"x6", or 6"x6"), paper facing down, mesh facing up. **(9)** Lap *at least* 6" (F). **(10)** Mop lap with waterproofing to prevent concrete while liquid from leaking through. **(11)** Now lay down a plain welded wire mesh (G) 6"x6", No. 10 gauge, no paper attached. **(12)** Pour concrete (H) to desired thickness. While pouring concrete, lift free wire mesh with hooks a few inches.

NOTE: It is advisable to drive the nails through the furring strips before applying them to the concrete joists.

From "Simplified Physics of Vapor & Thermal Insulation." 1951 Edition



INFRA THERMAL FACTORS, DOWNHEAT

Type 6 C.044 R22.72 = 9" Dry rockwool
Type 4 C.065 R15.38 = 6" Dry rockwool
Type 4 Jr.* C.097 R10.30 = 4⅛" Dry rockwool
***In 1" space.**

INFRA INSULATION, INC.
10 Murray Street, New York, N. Y.
Phone: CO 7-3833

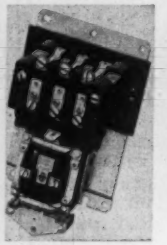
Infra Insulation, Inc., 10 Murray St., N. Y., N. Y.
Please send FREE "Simplified Physics of Vapor and Thermal Insulation," new summer 1951 edition.
Name_____
Firm_____
Address_____
☐ Send Prices of Infra Insulations
☐ Send Sample Dept. (H-9)

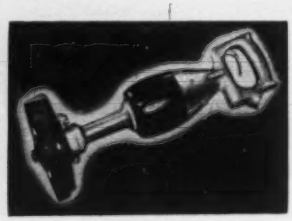
semblies for supplying water. Normally furnished as part of the complete pumps, they are suitable for outdoor operation where climatic conditions are not severe. The standardized base dimensions are the same as those for polyphase motors of the same size, permitting interchange without modification of the mounting.

Solenoid Contactor

HPAC 11—The new bulletin 4458 size O (15 amp) a-c solenoid contactor of Ward Leonard Electric Co., Mt. Vernon, N. Y., is designed for both load and control circuit use in controllers for refrigeration and air conditioning equipment and in similar applications. This multipole contactor is available in three-pole forms (illustrated) and five-pole forms. The double break silver contacts can be converted to normally open or normally closed contacts, a-c or d-c, without additional parts. A maximum of three normally closed poles can be obtained.

Maximum ratings are 2 hp, 440 or 550 volts, 3 phase 60 cycle current. Open 8 hr amp rating is 15 amp. Standard coils are available for 110, 220, 440 and 550 volt operation on 25, 50 or 60 cycles. The contactors can be furnished with d-c power plants for 115 or 230 volt operation.





Left: Contactor
Above: Grinder

Air Grinder

HPAC 12—A new air grinder for hand grinding operations in steel mills, foundries, etc., has been developed by Ingersoll-Rand Co., 11 Broadway, New York 4. It contains a motor governor to maintain correct wheel speed and a built in overspeed safety coupling unit. If the motor overspeeds, this unit automatically uncouples the arbor and the grinding wheel from the motor. The grinder also provides four possible exhaust positions. It is available for 8, 6, or 5 in. wheels, running at respective motor speeds of 3100, 4100 and 4500 rpm. The grinder weighs approximately 16½ lb with the guard.

Steel Tubing for Radiant Panel Heating Systems

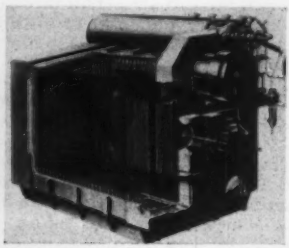
HPAC 13**—"Therma-Koil" flexible steel tubing, with corrosion-resistant exterior coating, has been developed by Thermapanels Inc., 342 Lincoln Ave., San Jose, Calif., for hot water radiant panel heating systems. Protection is provided by bonderizing of the exterior, resulting in a chemical conversion of the metallic surface to a non-metallic phosphate coating which, in addition, provides a mechanical bond for the finishing material. For further protection, a special chlorinated rubber base coating also is applied.

The tubing is available in two sizes — ½ in. and ⅜ in. ID, both with a wall thickness of .035. It is formed from SAE 1008 low carbon sheet steel, joined by a process of electric resistance welding, and is factory tested to withstand a working pressure of 1000 lb, the manufacturer states. Tubing is available in continuous lengths up to 500 ft, and in coils approximately 3½ ft in diameter.

Year Round Air Conditioning Unit

HPAC 14—A new compact air conditioning unit has been designed by The Trane Co., La Crosse, Wis., for concealed installations in hospitals, hotels, offices, etc. Suitable for either individual rooms, central systems, or the central zones of multi-room installations, this type AA air conditioner is available in both horizontal and vertical models with a wide range of coil combinations and motor arrangements. It can be installed in furred ceiling spaces, closets, utility areas, etc. The units operate with chilled water and hot water systems and are available with base air volumes ranging from 200 to 600 cfm.

Conditioner



Boiler

Integral Furnace Boiler

HPAC 15—The new type FM integral furnace boiler of Babcock & Wilcox Co., 85 Liberty St., New York 6, is a completely shop assembled steam generating unit available in standard sizes for loads ranging from 3000 to 26,000 lb per hr of steam, at pressures up to 250 psi. It is a water tube boiler, with a completely water cooled furnace. There is automatic control for handling variations in load. The unit is designed especially for use in small and medium sized plants.

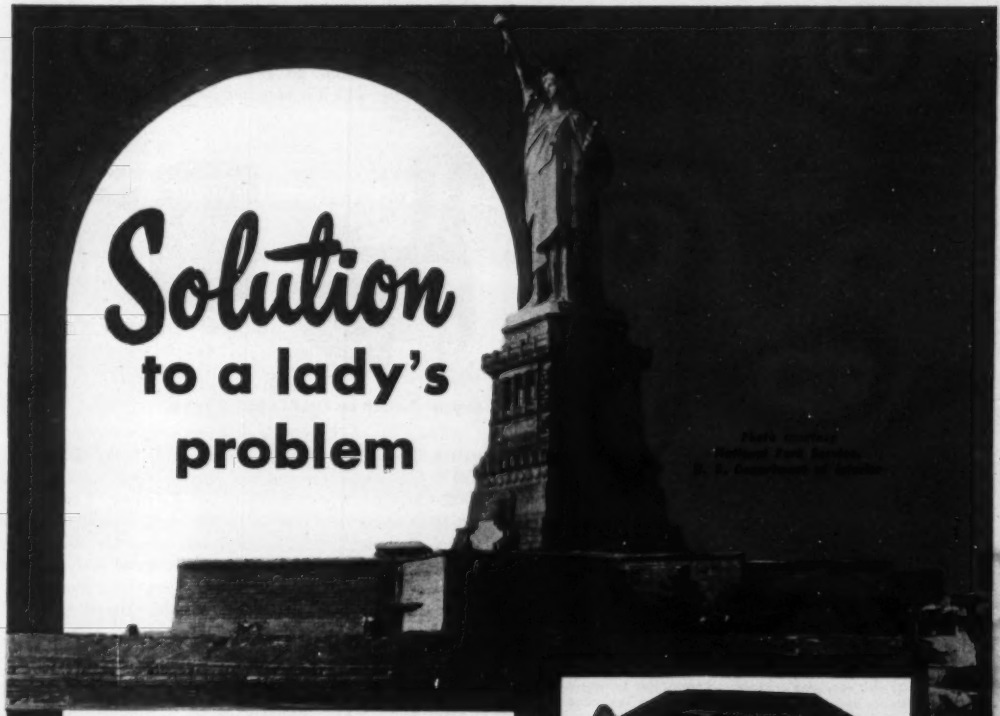
Insulation for Refrigerated Equipment

HPAC 16—The development of a new and improved series of "Fiberglas" insulation for refrigerated equipment has been announced by the Building Materials Div., Armstrong Cork Co., 440 Concord St., Lancaster, Pa. The new 500 series, which will replace most of the 600 series, was made possible through the development of improved production equipment which enabled the manufacturer, Owens-Corning Fiberglas Corp., to reduce fiber sizes. The new series shows improvement over the former series in conductivity and general performance (K factors are lower). Remaining in the 600 series will be 614, 615 and 617 which are used for sound deadening and load bearing.

Condensate Return Unit

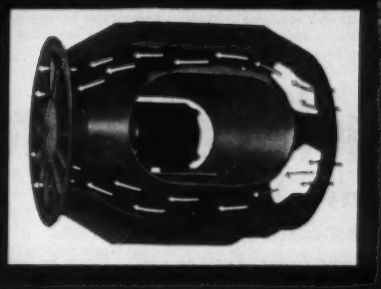
HPAC 17—The new vertical condensate return units of Roy E. Roth Co., 2420 4th Ave., Rock Island, Ill., have been developed for applications of up to 8000 sq ft EDR at 20 psi. Two sizes cover this range. The vertical design is intended particularly for installations where the

Solution to a lady's problem



When officials of the National Park Service decided to install a heating system in the Statue of Liberty, they were faced with the problem of how to provide adequate draft for a boiler without marring the statue's appearance. Obviously a tall stack wouldn't do, and an added complication was the fact that inside the statue's base only a small space was available for the entire system.

The problem was neatly solved by installing a DeBothezat Induced Draft Bifurcator Fan in the horizontal breeching adjacent to the boiler. Since DeBothezat Bifurcator Fans provide positive controlled draft at all times, the statue required no stack except a stub stack three feet high. The heating system is operating at peak efficiency, keeping the half-million tourists who visit the Statue of Liberty every year as comfortable in the winter as in the summer.

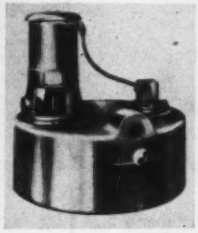


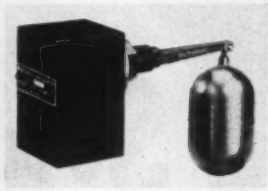
Send for Bulletin

Ask your DeBothezat Fans man for the illustrated bulletin on Induced Draft Bifurcators, or write our factory, Dept. HP951.

Approved
By AGA and UL — because they meet the highest standards of efficiency and safety.
Propeller-Fan Type 150
Specified
By architects, engineers, and builders because they — save space, save time, save construction costs.
Blower Type 151
Superior
For long-life, efficiency, and economy because they are advanced in design, and quality built.
Low Cost
Competitive for any job because they are sized right, priced right.
Mueller Climatrol
unit heaters
Direct Gas-fired, Propeller Fan and Blower Types, Easy to sell...Easy to install!
Floor Model Type UH Unit Heater
Direct gas-fired. Ideal for factories, garages, etc. Designed for quick installation, efficient and economical operation. Sectional construction for capacities from 180,000 to 540,000 Btu input. AGA approved.
With Mueller Climatrol you can go out and get any job — where time and construction short-cuts are prime factors . . . where compact, efficient heating is in demand.
These design features give you a real selling advantage:
✓ One piece, all-welded steel — no joints to leak, separate, or crack.
✓ High Crown sheet — no "hot spots", no joints or welds exposed to flame or flue gas.
✓ Uniform air flow and heat distribution — insures maximum heat transfer and fuel economy.
Get behind the Mueller Climatrol unit heater. Sales come easy — installation is simple (units shipped pre-wired and assembled). Write for information . . . L. J. Mueller Furnace Company, 2023K W. Oklahoma Ave., Milwaukee 15, Wisconsin.
94th Anniversary
Mueller Climatrol
D-119A

return piping is close to floor level. Units occupy a minimum of floor space, the manufacturer states. They can be installed in a shallow pit, if desired, without risk of flooding the motor, which is mounted vertically above the pump and receiver.





Left: Condensate Return
Above: Switch

Signal Switch or Fuel Cutoff Device

HPAC 18—A heavier, improved float operated signal switch designed to operate on pressures from vacuum to 450 lb has been developed by Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3. The new "Levalarm" EA-10 is used to set off warning signals such as bells, sirens or lights when liquid levels in small boilers or various types of tanks reach predetermined low or high points. It also can be used as a fuel cutoff for low water. In conjunction with water columns the float lever is inserted into the alarm valve opening.

Window Type Air Conditioner

HPAC 19—United States Air Conditioning Corp., 3300 Como Ave., S.E., Minneapolis 14, is offering its 1952 redesigned window type room air conditioner. A manual control on the top of the cabinet regulates an exhaust damper which functions independently of the cooling section and can be used in cold weather to exhaust stale or smoky room air. The unit is available in a ½ hp size, recommended for rooms with 200 to 300 sq ft of floor space, and in a ¾ hp size, for rooms with 300 to 450 sq ft of floor space.

Conditioner

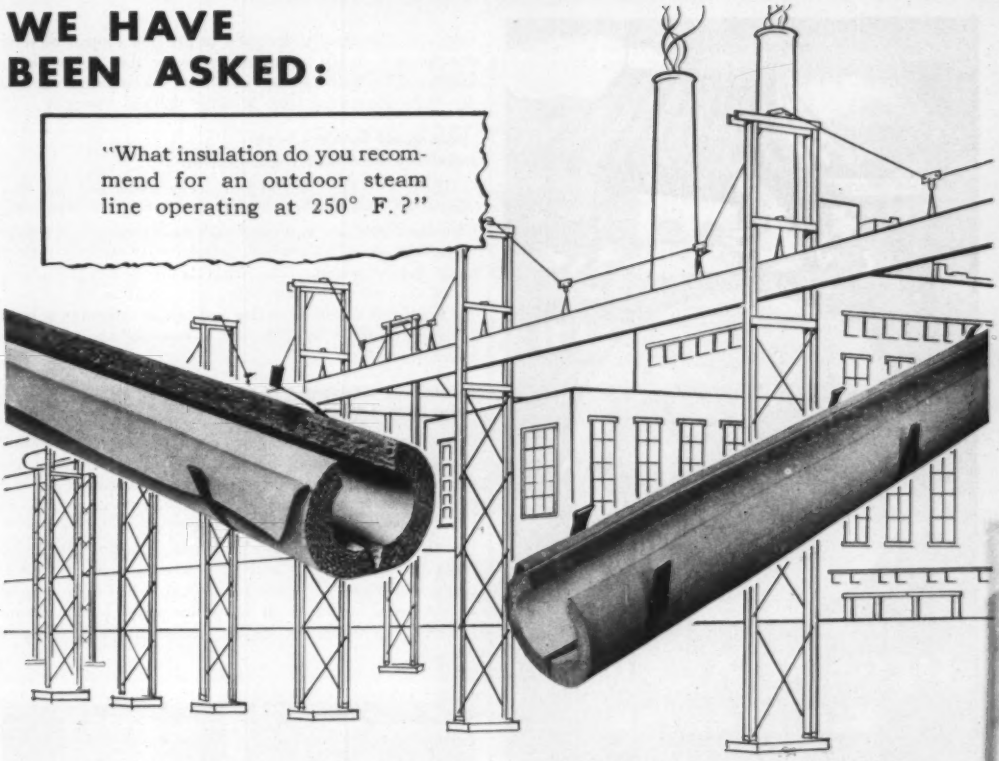
Thermostat

Remote Bulb Thermostat

HPAC 20—The new type NWDH remote bulb thermostat of United Electric Controls Co., 85 School St., Watertown 72, Mass., incorporates two precision, snap-action switches. A variety of temperature ranges are available between the limits of –150 and 600 F. Uncalibrated adjustments are provided which permit settings of the operating range as well as the differential between the two switches (which may be set as close as 2 deg, the manufacturer states). The switches handle non-inductive loads up to 20 amp and motor loads of 1½ hp at 220

WE HAVE BEEN ASKED:

"What insulation do you recommend for an outdoor steam line operating at 250° F.?"



"In a few months, we will have some outdoor steam lines installed in our plant," writes a power plant engineer. "Operating temperature will be 250° F.—pressure, 15 lbs. We plan to use Air Cell Pipe Covering but wanted to check this with you before we went ahead with the job. Is this the insulation that you would recommend?"

Chances are that the writer based his choice of insulation only on the fact that operating temperature would be 250° F. Air Cell is often the recommended insulation for temperatures up to 300° F. In this case, however, the outdoor location makes 85% Magnesia a much sounder investment.

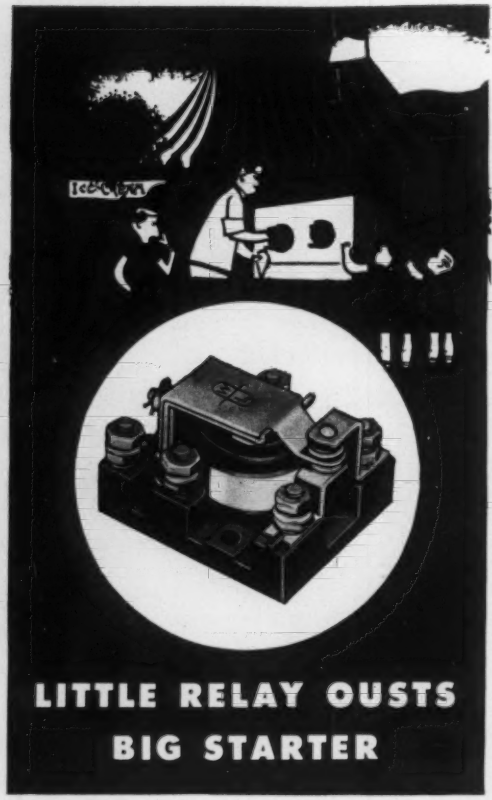
85% Magnesia gives outstanding service under rugged outdoor conditions. If weatherproofing felt over the pipe covering breaks or loosens and water seeps through, the heat of the line dries out the Magnesia and restores its original efficiency. The covering does not shrink or deteriorate.

Air Cell Pipe Covering, on the other hand, is an efficient, low-cost insulation that gives good service on indoor applications where it isn't subjected to severe conditions of dampness, bumping, or abrasion.

This question points up an important part of every insulation job; double-checking your choice of insulation *before* you put it up. Trained engineers in a near-by Armstrong office will be glad to go over the specifications for any job you may be contemplating. They can also give you details on the quality materials and expert installation service offered by Armstrong's contracting organization.

SEND US YOUR QUESTIONS: If you have any questions on the use or application of either high- or low-temperature insulation, please do not hesitate to write to us. We'll do our best to give you a practical answer. Just address a letter or card to Armstrong Cork Co., 4409 Maple Avenue, Lancaster, Penna.

ARMSTRONG'S INDUSTRIAL INSULATIONS



LITTLE RELAY OUSTS BIG STARTER

and saves customer both space and money

An ice cream freezer manufacturer* was perfectly content with the across-the-line starters used in his equipment.

But we got the idea of saving him some room and dollars by substituting Ward Leonard heavy-duty midget *relays.*

It's a really rugged relay, and certain types are Underwriters' listed as motor controllers. Months of testing proved that a standard Ward Leonard relay with just slight changes would do the job of the heavier starter.

It's another case of Ward Leonard "Result-Engineering" Write us for Bulletin 105 on the heavy-duty midget relay, or for *any* control problem, write WARD LEONARD ELECTRIC CO. 24 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

*Sweden Freezer Manufacturing Company, Seattle, Washington.

WARD LEONARD ELECTRIC COMPANY

Result-Engineered Controls Since 1892

RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES

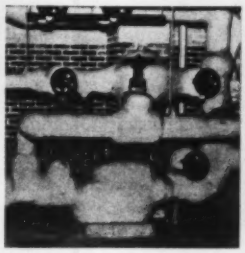
volts a-c. Originally designed to provide control of dual compressors in air conditioning units, the theromstat is applicable in many industries where two separate circuits are to be controlled from a single thermal assembly.

Underfeed Stokers with Infinitely Variable Transmission

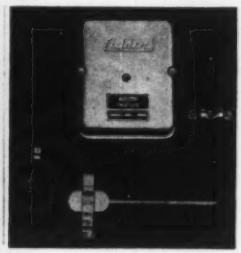
HPAC 21—The CF and PCF series underfeed coal flow stokers of Iron Fireman Mfg. Co., 3170 W. 106th St., Cleveland, are now equipped with the company's infinitely variable transmission which adjusts coal feeding rate to exact load demand. The variable drive is particularly suited for use with modulating type combustion controls. An automatic overload device and torque indicator is built into the transmission. The unit is mounted above the conveyor worm.

Insulating Cement

HPAC 22—A new mineral wool insulating cement, MW-50, is now being produced by Philip Carey Mfg. Co., Wayne Ave., Lockland, Cincinnati 15. Composed of mineral wool pellets, asbestos fibers, bonding clay and rust inhibitor, it is especially adaptable to large, monolithic construction on furnace walls, tanks and boilers. It can also be used to insulate odd or irregularly shaped surfaces, grouped fittings and process equipment. The cement, which can be applied with a trowel, bonds to cold or hot metal surfaces. It is recommended by the manufacturer for insulation against temperatures ranging to 1600 F.



Cement



Control

Level Control for Liquids and Solids

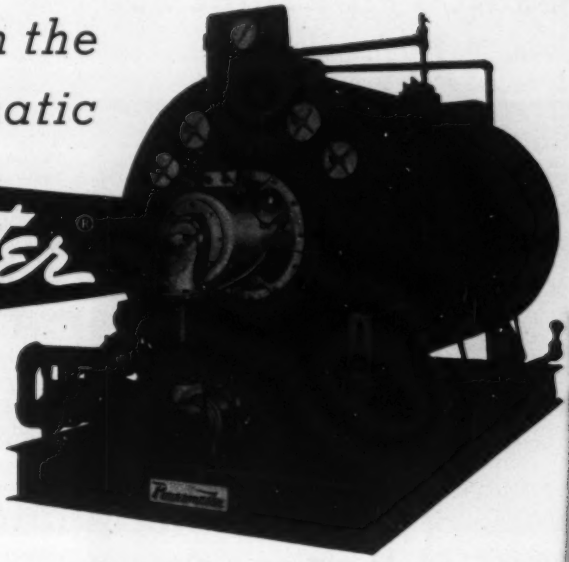
HPAC 23**—The "Tektor" level switch of Fielden Instrument Corp., 2920 N. 4th St., Philadelphia 33, makes possible level control of most liquids with high or low viscosity and electrical conducting or insulating properties, and of powder, granular solids, coal, etc., with sensing electrodes suitable to the specific problem. No electrical contact is necessary with the material under control, and the equipment does not require floats, diaphragms, or any moving mechanical parts. On the standard model, AJ-1, the electrode consists of a simple probe inserted into the container at the level at which control is desired. A level differential of 1/32 to 3/8 in. may be obtained, the manufacturer states.

Ion Exchanger for Water Treatment

HPAC 24—The new "Dual Bed" ion exchange unit developed by Permutit Co., 330 W. 42nd St., New York, utilizes resins that are regenerated with simple salt. The

now you can reduce steam costs with the automatic

Powermaster®



Model 3 *Powermaster*—15 to 500 H.P.; high or low pressure models for steam or hot water.

Exclusive burner design (patent applied for) is yours with the *Powermaster* steam generator. Compare this unit with others and you'll see why users are saving hundreds of dollars on fuel bills. Only the *Powermaster* gives you these 3 definite ways to reduce your costs for steam or hot water—

1. *Use less fuel* when boiler operates between 100% and 30% of capacity. Special burner gives you full modulation in a wide range between high and low fire.

2. *Save clean-up time* and money because complete combustion of fuel gives practically smokeless and carbon-free operation. Case histories show that the *Powermaster* needs cleaning less often than other self-contained units.

3. *Change from oil to gas* (or gas to oil) in just a few minutes. Take advantage of low fuel rates, enjoy freedom from worry about fuel shortages.

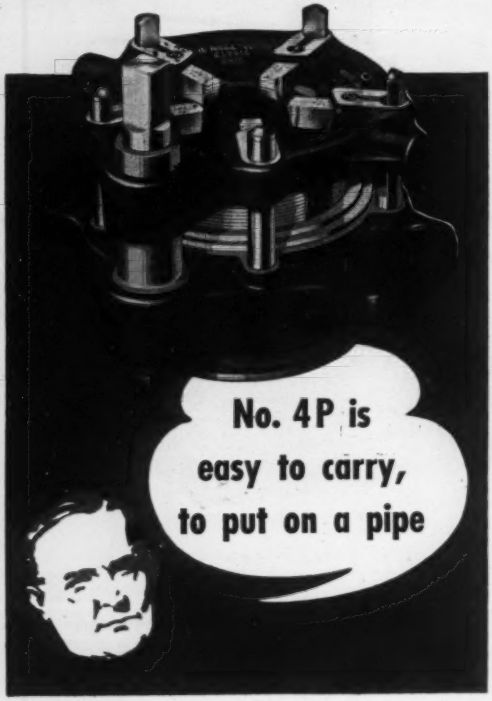
only the **Powermaster®** *gives you all 3 advantages*

Write for this catalog

that gives you the entire story of the *Powermaster* steam generator. Just ask for Catalog 1218 and we'll put one in the mail for you.

ORR & SEMBOWER, INC., *Established 1885*
990 Morgantown Road, Reading, Pennsylvania

Easier to Handle this RIDGID Geared Pipe Threader



● You'll like the balanced loop handles that make it easy to swing the 4P around where you want it. Making it still more of a work-saver, mistake-proof workholder sets to size *before* you put it on pipe—only one screw to tighten, no bushings to fool with. 4 sets of 5 high-speed steel chaser dies give quick, clean threads on 2½", 3", 3½" and 4" pipe. Ratchet handle furnished—for power threading use with RIDGID Universal Drive Shaft and Power Drive. Save your muscles—buy this easier-to-handle RIDGID 4P at your Supply House.

RIDGID
★ Work-Saver Pipe Tools ★

unit cannot produce an acid water during the treating step or acid waste waters during regeneration, the manufacturer states. It will be used principally to soften and to remove alkalinity from boiler feedwater in industrial plants. The new resins also remove sulfates.

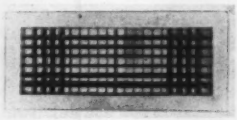
Pilot Controlled Valve

HPAC 25—The new pilot controlled valve (internal piston operated) of Automatic Switch Co., Orange, N.J., is designed to control automatically the alternate application and exhaustion of pressure to and from equipment, cylinders or diaphragm chambers, as in the operation of diaphragm motor valves, air or hydraulic cylinders, etc. When the solenoid is energized, the exhaust port is closed and the pressure is applied to the delivery port. When it is de-energized, pressure is cut off and the delivery port is connected to the exhaust. The internal piston actuating the main valve is controlled by a three way solenoid pilot valve.

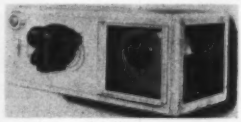
These No. 8331 valves are suitable for handling air, gas, oil or any other non-corrosive fluid at temperatures not exceeding 180 F. Pipe sizes are 1, 1¼, 1½ and 2 in., each with designs suitable for 125 and 250 lb operating pressures. Standard solenoids are for 115 or 230 volts a-c or d-c and for 25, 30, 50 or 60 cycles.

Air Conditioning Grille

HPAC 26—A new one piece, extra heavy frame air conditioning outlet, grille No. 270, is being manufactured by Titus Mfg. Corp., Waterloo, Iowa. It has an airtight gasket, and individual blade adjustment, and it has been wind tunnel tested to give even, noise and turbulence free performance, the manufacturer states. The grille features the company's "Airfoil" louver, which is a solid section (made from extruded aluminum). Two sets of these louvers give four-way air distribution.



Grille



Conditioner

Suspended Winter Air Conditioners

HPAC 27—Three new models of suspended type oil-fired winter air conditioners, with outputs at the bonnet of 115,000, 150,000 and 205,000 Btu per hr, are now offered by York-Shipley, Inc., York, Pa. The new conditioners use shutter-type burners, but have been designed as complete units. Jacket sizes range from 26 in. square by 61 in. long to 33 in. square by 88 in. long.

General Purpose Pumps

HPAC 28—A new line of general purpose centrifugal pumps is now being offered by Economy Pumps, Inc., division of Hamilton-Thomas Corp., Hamilton, Ohio. The new Type SCC pumps, with capacities ranging to 100 gpm at heads to 120 ft, are suitable for use with small cooling towers, for booster and process pumping, etc. They have standard open drip type motors and are available in two sizes, 2 in. suction x 1¼ in. discharge and 1½ in. x ¾ in, both of which operate at 3450 rpm.

Bundyweld Tubing shines in better radiant heating systems

Shines in *on-the-site* fabrication, too.

Bundyweld is the only tubing double-walled from a single strip, with an exclusive beveled edge. It is copper-brazed, perfectly bonded through 360° of wall contact, into a solid-walled tube with thinner yet stronger walls. It is held to close tolerances.

Scale-free and smooth inside and out, Bundyweld arrives at the building site in twenty-foot lengths, with one end expanded if specified.

One man quickly bends grids on a simple wood or metal form and joins them by soft or silver soldering. Two men easily position the lightweight, rigid, joined grids. Bundyweld shines, too, in your radiant heating systems. It's extra sturdy with a margin of safety against leaks or bursts under normal pressure. Its thinner wall radiates heat faster for more effective performance. You can already see that Bundyweld offers many unique performance and fabrication advantages that mean time, work, and money saved. But there are more. Check *Sweet's Architectural File* for details. Or write us. ***Bundy Tubing Company, Detroit 14, Michigan.***

Bundyweld® Tubing

DOUBLE-WALLED FROM A SINGLE STRIP

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of basic metal, coated with a bonding metal. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

passed through a furnace. Bonding metal fuses with basic metal, presto—

Bundyweld . . . double-walled and brazed through 360° of wall contact.

NOTE the exclusive patented Bundyweld beveled edge, which affords a smoother joint, absence of bead and less chance for any leakage.

ENGINEERED
for tomorrow

. . . Badger EXPANSION JOINTS . . . assure long, trouble-free life . . . an engineering masterpiece

Leading utilities are erecting ultra-modern power plants which are both *designed* and *engineered* for tomorrow. The structures represent the very latest trends in functional design . . . and the steam distribution systems must be engineered to perform with maximum efficiency. As you would expect, Badger Corrugated Packless Expansion Joints, constructed to the famous Directed-Flexing Self-Equalizing design are first choice with these forward-looking utilities.

* * * * * *

What's the reason you find Badger Expansion Joints specified on *important* jobs? Because engineers have learned from years of experience to put their faith in the performance of Badger Joints . . . performance that's a result of construction features like these:

- Directed-Flexing Self-Equalizing rings . . . progressively control the movement of the all-curve corrugations.
- Packless . . . pressure-tight single tube — requires no maintenance.
- Compact . . . approximately the size of flanged fitting.
- Special forming . . . no structure-weakening stresses.
- Controlled heat treating . . . assures long life.
- Wide range of traverse — pressure — temperature.

Fabricated from deoxidized copper for normal pressures and temperatures, stainless steel or alloys to withstand high pressure, temperature and corrosion.

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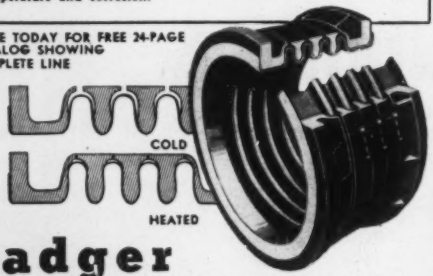


Badger
MANUFACTURING COMPANY
230 BENT STREET, CAMBRIDGE, MASS.

EQUIPMENT BRIEFS

A new comparison testing machine developed by *EDWARD VALVES, INC.*, East Chicago, Ind., utilizes fluid gages to register valve pressure drops. Half section valves of the check type design, as used in 900 lb sp boiler feedwater service, are used in the comparison test. The test shows that the streamlined Edward valve has a low pressure loss and full lift of the valve piston, the manufacturer states.

In line with the company's policy of conserving nickel supplies as far as possible during the current period of emergency, *INTERNATIONAL NICKEL CO.*, New York, has developed an alloy, "Incoloy," for use under conditions of high temperature and corrosion. It contains about 35 percent nickel and 20 percent chromium, with the balance iron. The alloy is produced in most standard rolling mill forms, including sheet, strip, rod, wire and tubing.

Fuel pump castings formerly rejected because of worn and stripped threads are now being salvaged with "Heli-Coil" stainless steel thread inserts (manufactured by Heli-Coil Corp., Long Island City, N.Y.) in the rebuilding dept. of *SID HARVEY, INC.*, Valley Stream, N.Y. Between 10 and 20 defective fuel unit castings, or about 1 percent of the units processed by this dealer, are repaired by the wire insert method each week. At a saving of $3.00 per casting, this amounts to a yearly saving of over $2000. Repair operations follow this pattern: first, the damaged thread is cut out with a drill larger in diameter than the major diameter of the original thread; second, the hole is rethreaded with an oversize tap; and third, a thread insert is installed.

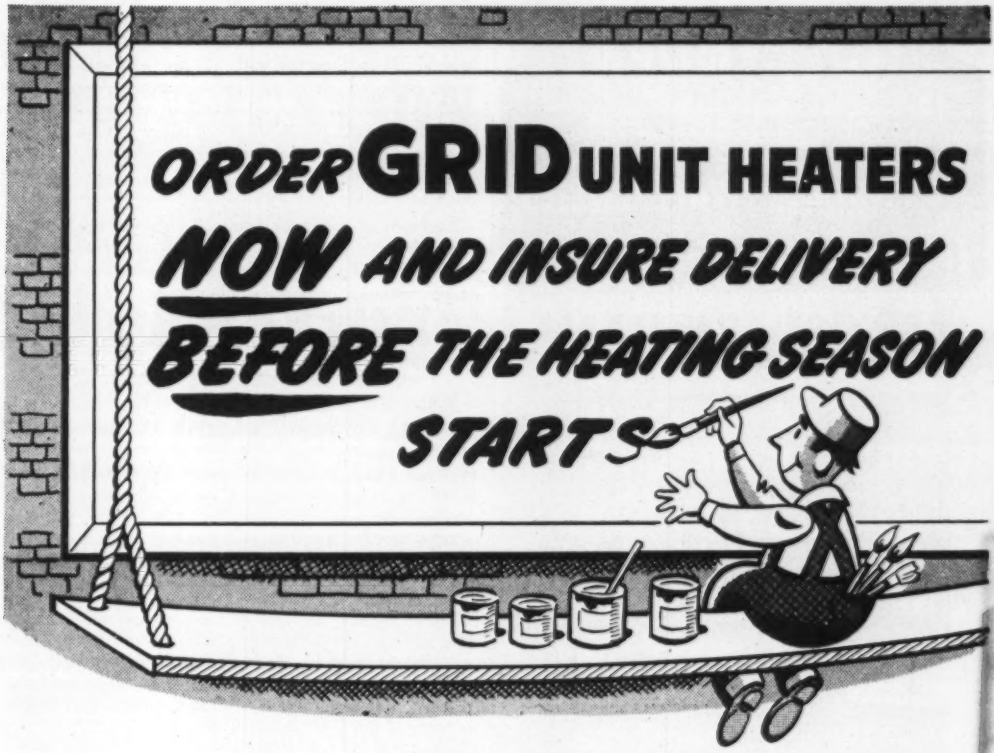
A new, extra-strong steel casing developed by *NATIONAL TUBE CO.* is designed to withstand the great pressures of deep oil wells. The casing is now being produced on newly installed equipment at the McKeesport, Pa., National Works of this *U. S. STEEL CORP.* subsidiary. The manufacturer states that the physical properties of commercially produced 7 in. OD casing are 110,000 psi minimum yield strength at 0.6 percent total strain, 139,000 psi average ultimate strength and 22.4 percent average elongation in 2 in.

WE HEAR THAT . . .

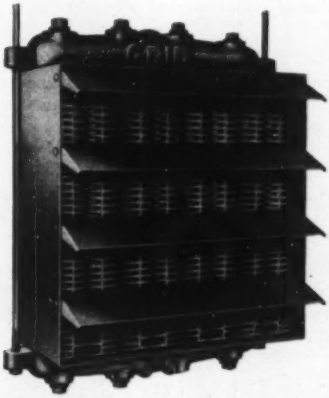
The general offices and factory of *POWERS REGULATOR CO.* are now located in the company's new plant at 3400 Oakton St., Skokie, Ill.

A new plan, "productive maintenance," inaugurated by *GENERAL ELECTRIC CO.*, Schenectady 5, N. Y., is designed to assist maintenance engineers in setting up a program to minimize lost production time and equipment failures. In this plan, the company recommends (1) an adequate staff of trained maintenance men armed with (2) the tools needed to perform properly the functions of (3) regular, routine checks of operating equipment

ORDER GRID UNIT HEATERS NOW AND INSURE DELIVERY BEFORE THE HEATING SEASON START



Double your money's worth — if you order GRID Unit Heaters NOW — in advance of the regular heating season, because our inventory on GRID Unit Heaters is the best in years. And, GRID Unit Heaters are the best heating buy from the standpoint of maintenance-free service and low cost of operation. There is no waiting for delivery on GRID Unit Heaters and there is no maintenance after you get them, because . . .



GRID cast iron construction withstands corrosive fumes.

GRID wide fin spacing facilitates easy cleaning.

GRID will withstand steam pressures up to 250 lbs., and is free of electrolysis.

GRID fins are cast integral with the steam chamber assuring even distribution of heat. It's not possible for GRID fins to come loose from the steam chamber to cause loss of heating efficiency.

GRID design incorporating proper fan sizes, motor speeds and outlet temperatures results in a properly balanced heating unit, especially when high steam pressures are used.

Consult our Engineering Department and Sales representatives for advice on heating problems, including Unit Heaters, Blast Coils and Radiation. Send for complete catalog . . . no cost . . . no obligation.

THE UNIT HEATER WITH HIGH TEST CAST IRON HEATING SECTIONS . . . FREE OF ELECTROLYSIS

D. J. MURRAY MANUFACTURING CO

MANUFACTURERS SINCE 1883

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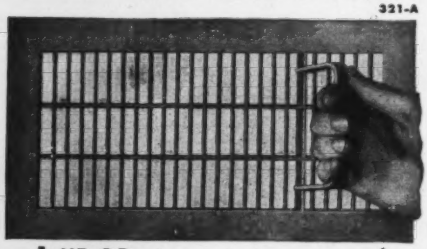
"Fabrikated" WALL GRILLES for Commercial Installations

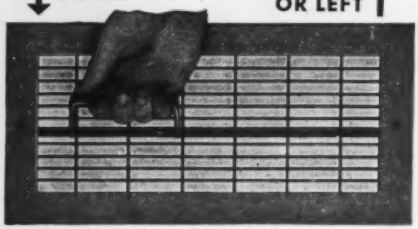
PROVIDE ADJUSTABLE DIRECTED AIR FLOW

321-A



UP OR DOWN

RIGHT OR LEFT



311-A

Made to fit openings in even inches from 8" x 4" to 60" x 40"

Independent Fabrikated* Adjustable Grilles (patented), rigidly constructed with stamped steel rims and steel bars, are made with either vertical or horizontal grille bars. Grille bars are *adjustable* before or after installation; available also with bars permanently set for straight flow.

Write for new Catalog No. 50—gives schedule of sizes, details and prices.

Always Leading — Always Progressing

*Reg. U. S. Pat. Off.

THE INDEPENDENT REGISTER CO.

3747 E. 93rd STREET · CLEVELAND, OHIO

and (4) planned outage of this equipment at regular intervals. Machines can be rebuilt and modernized during time of planned outage with (5) an adequate stock of mechanical and electrical renewal parts. A productive maintenance kit is offered, containing an instruction bulletin, a typical balance sheet for keeping data on each machine, planned outage forms and checklists for motors, controls and other equipment.

Engineering graduates from 20 colleges took part recently in the annual training program of *JOHNSON SERVICE CO.*, Milwaukee. The intensive six-week course included classroom discussions and demonstrations, laboratory work, and field trips to company projects. The program is directed by *J. R. VERNON*, sales promotion manager.

A $500,000 modernization of its Oil City, Pa., plant is planned by *WORTHINGTON PUMP AND MACHINERY CORP.*, Harrison, N. J. The present foundry will be re-equipped and a new electric power supply will be established.

MUNTZ TV, INC., Chicago, soon will begin production of air conditioning units, having acquired the tools, dies and entire inventory of the room air conditioners of *TROPICAIRE, INC.*, Chicago.

A recent "house warming" for employees and their families celebrated the completion of the move to South Norwalk, Conn., by *PRAT-DANIEL CORP.* The company had for the past seventeen years been located at Port Chester, Conn., but the plant expansion necessary for meeting increased orders was not possible at the old location.

Net sales billed by the *WESTINGHOUSE ELECTRIC CORP.*, Pittsburgh, in the first half of 1951 totaled $590,562,000, a new record. The company's previous highest half year sales record was $558,192,000 in the last half of 1950.

Basic facts about the all purpose metal framing of *UNISTRUT PRODUCTS CO.*, Chicago, and practical suggestions on its uses (including support of piping) are now demonstrated for architects, engineers, and contractors in a new permanent display located on the balcony floor at the *ARCHITECTS SAMPLES CORP.*, 101 Park Ave., New York.

Construction of a new plant near Kansas City, Mo., for *FAIRBANKS, MORSE & CO.*, Chicago, will be started immediately by the Stone & Webster Engineering Corp. It will contain 500,000 sq ft of floor space, including a foundry, and will be used to make engines and pumps.

A demonstration of the "Blo-Crete" method of applying concrete by machine, and discussion of the "Z-Crete" method of cast-in-place, monolithic pipe insulation highlighted the recent second annual convention of licensed "Z-Crete" applicators held in Kansas City, Mo. Sessions were presided over by *D. C. GOFF*, manager, Z-Crete div., *ZONOLITE CO.*, Chicago.

for

SPECIFICATION

and

BUYING INFORMATION

Use your complete, up-to-date

JANUARY DIRECTORY ISSUE

Your job will be a lot easier if you'll keep the January Directory issue of Heating, Piping & Air Conditioning constantly available for handy reference. It's one of your most valuable tools — one which will save you many hours of looking up the products you need for your various jobs. It's the ONE complete, up-to-date, readily accessible source of product information on who makes the pumps, valves, traps, compressors, specialties of all kinds, etc., you need — and where they're located. They're indentified by trade names, too. EVERY product is listed, alphabetically arranged and printed on a distinctive yellow stock for easy reading and reference.
Keep it handy . . . the time you save with it can be used to advantage in other ways.

. . . here's what other engineers and contractors have to say . . .

"Your Directory issue is an excellent buyers' guide. We use it a great many times during the course of the year." *BOSTON ENGINEER*

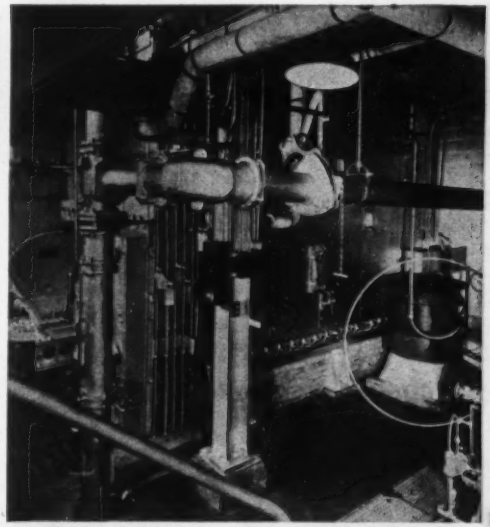
"We find both Directory and Advertising Section helpful. The advertising gives us the product details we need." *CHICAGO CONTRACTOR*

"Your directory stays in this office until the next January issue comes along. Numerous times we refer to it." *FORT WAYNE CONTRACTOR*

"In our work, we make use of your Directory time and time again. Our reference file would not be complete without it." *LOS ANGELES ENGINEER*

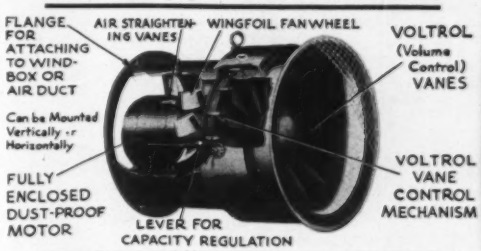
REMEMBER — EVERY product is right at your fingertips

HEATING, PIPING & AIR CONDITIONING
6 North Michigan Ave. Chicago 2, Ill.



COMPACTNESS, EASE OF REGULATION, LOW MAINTENANCE — — IN THE WING AXIAL FLOW BLOWER

WING AXIAL FLOW BLOWERS are used on many of the country's leading makes of boilers as standard equipment. The reason lies in the


FLANGE FOR ATTACHING TO WIND-BOX OR AIR DUCT
AIR STRAIGHTENING VANES
WINGFOIL FANWHEEL
VOLTROL (Volume Control) VANES
Can be Mounted Vertically or Horizontally
FULLY ENCLOSED DUST-PROOF MOTOR
VOLTROL VANE CONTROL MECHANISM
LEVER FOR CAPACITY REGULATION

consistently satisfactory performance Wing Blowers have been delivering for over half-a-century—plus many superior features of Wing design, such as the volume control (Voltrol) vanes, permitting capacity regulation down to 10% of maximum. Write for complete details and latest bulletin

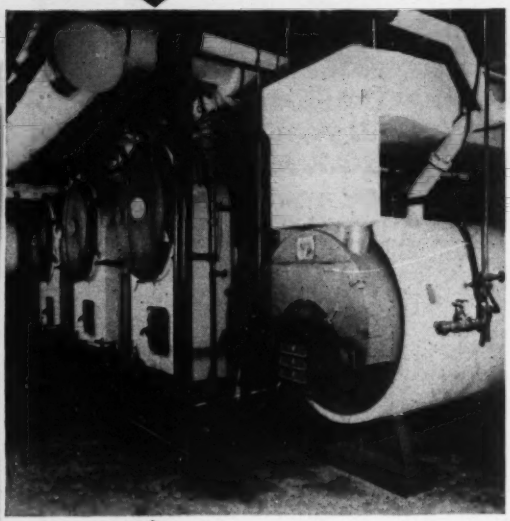
L. J. Wing Mfg. Co. 140 Vreeland Mills Road Linden, New Jersey
Offices in Principal Cities

Wing
AXIAL FLOW BLOWERS

For "Bedrock Economy" in HEATING and POWER

Choose and use

TITUSVILLE BOILERS



Compact, efficient layout distinguishes this Titusville boiler installation.

Here in the boiler room of the new Booker T. Washington High School in Shreveport, La., are shown three Titusville "Compact" Steel Heating Boilers (total rated capacity in excess of 36,000 sq. ft.), with a 30 H.P. Titusville "Wee Scot" marine boiler serving laundry and kitchen. The complete range of Titusville boilers enables many ideal service combinations. *Write us for details.*

THE TITUSVILLE IRON WORKS COMPANY

A division of Struthers Wells

Representatives in Principal Cities

TITUSVILLE, PENNSYLVANIA

THE INDUSTRIAL MINERAL WOOL INSTITUTE, New York, has launched an industry-wide certification program designed to assure standard quality and protect industrial users of mineral wool products. Each carton or section of insulation manufactured by the Institute's member companies (now numbering 16) will carry a label certifying that its properties exceed minimum requirements prescribed in two commercial standards issued by the National Bureau of Standards, U. S. Department of Commerce (Standards CS117-49 and CS105-48).

GENERAL ELECTRIC CO., Schenectady, N. Y., has announced that in the first six months of this year, its sales of $1,184,735,000 and its pre-tax earnings of $212,326,000 exceeded by 34 and 55 percent, respectively, the previous record levels for this period attained last year. However, due to an increase of 139 percent in the provision required for federal taxes on income, the net profit of $70,326,000 earned in this six months was 9 percent less than the $77,445,000 earned in the corresponding period a year ago.

TIMKEN SILENT AUTOMATIC DIV., Jackson, Mich., officially launched a fall selling campaign recently with a meeting of all regional managers. Held in Jackson, the two day meeting included talks and round table discussions on many subjects pertinent to sales plans and objectives for the coming months.

WESTERN ENGINEERING AND MANUFACTURING CO., Los Angeles, has outgrown its present location and has begun work on a new home plant which will be at 4114 Ocean Park Ave., Los Angeles. Located on a two acre plot, the actual building will occupy 19,000 sq ft. It will be completed in the fall.

IDWAL PARRI, field education director, *PERFEX CORP.*, Milwaukee, conducted the first of a series of distributor schools in Chicago recently. The schools are cooperative ventures between the company and its distributors. Classes are held on three successive evenings, and the course covers fundamentals in electricity, actuating devices, control systems and field service problems.

JOHNSON-WILLIAMS, LTD., Palo Alto, Calif., manufacturer of combustible gas indicators and alarms for industrial and marine application, has doubled the production space at its Palo Alto plant. New facilities will be devoted to laboratory and machine shop operations.

Construction is under way in the $10,000,000 plant expansion, equipment and machinery replacement program of *SKF INDUSTRIES, INC.*, Philadelphia. Plant no. 1 in Philadelphia will have a laboratory addition, a new building fronting to house finished stores and a bridge connecting the main factory with the new addition. The Shippensburg, Pa., plant and the Philadelphia plant no. 2 also will be expanded.

CHICAGO STEEL SERVICE CO., has moved into its new general office and warehouse on Kildare Ave. at 45th St., Chicago. The $1,500,000 warehouse provides 120,000 sq ft of floor space.

WHO'S WHAT

Recently elected to the board of directors of *ALLIS-CHALMERS MFG. CO.*, Milwaukee, are *J. L. SINGLETON*, vice president in charge of the general machinery division, and *R. S. STEVENSON*, vice president in charge of the tractor division. They succeed as directors the late *WALTER GEIST* and *W. C. JOHNSON*. *W. E. HAWKINSON*, who will retain his post as secretary-treasurer of the company, was named a vice president.

The new secretary of *IRON FIREMAN MFG. CO.*, Cleveland, is *C. C. CRAFT*, formerly assistant secretary and division controller. . . . . *SECOR D. BROWNE*, until recently with Barber-Colman Co., is now associated with *CLIFFORD MFG. CO.*, Waltham, Mass., manufacturers of bellows and aircraft heat exchangers.

NATHAN R. JOHNSON, director and factory manager of *BUFFALO FORGE CO.*, Buffalo, is retiring after almost 35 years with the company. Succeeding him, with the title of manufacturing director, is *WILLIAM R. HEATH*, chief engineer since 1948. The new chief engineer is *JOHN E. GILL*, most recently in charge of pressure blower and axial flow fan sales. *GEORGE P. SCHIVLEY*, formerly plant superintendent, is now plant manager.

A number of the product-sections of the *AIR CONDITIONING AND REFRIGERATING MACHINERY ASSOCIATION* have elected officers in recent meetings. For the room air conditioner section — chairman, *M. T. BARD*, Airtemp div., Chrysler Corp.; vice chairman, *H. L. LAUBE*, Remington Corp.; and engineering committee chairman, *W. L. McGRATH*, Carrier Corp. For the self-contained air conditioner section — chairman, *T. E. SMITH*, Westinghouse Electric Corp; vice chairman, *W. G. COX*, General Electric Co.; and engineering committee chairman, *R. E. HOLMES*, Worthington Pump and Machinery Corp.

For the small compressor and condensing unit section — chairman, *C. E. PLOEGER*, Servel, Inc.; vice chairman, *F. E. LEHMAN*, Frigidaire div., General Motors Corp.; engineering committee chairman, *W. L. KNAUS*, General Electric Co. For the central station air conditioning and refrigeration equipment section — chairman, *O. E. GAMMILL, JR.*, Carrier Corp.; vice chairman, *J. R. HERTZLER*, York Corp.; engineering committee chairman, *A. J. MALLINCKRODT*, Baker Refrigeration Corp. For the large compressor and condensing unit section — chairman, *F. W. SMITH*, Baker Refrigeration Corp.; vice chairman, *W. H. AUBREY*, Frick Co., Inc.; engineering committee chairman, *E. B. DUNPHY*, Acme Industries, Inc.

RALPH H. ANDERSON, director of procurement for *CARRIER CORP.*, Syracuse, N.Y., has been appointed to replace *GEORGE N. LILYGREN*, company vice president now on loan to the government, as one of three top assistants to the director of program and requirements for the Defense Production Administration.

For Measuring...

AIR VELOCITY

THE HASTINGS AIR-METER

SO SMALL IT FITS IN THE PALM OF YOUR HAND*

IDEAL FOR:

- Laboratories
- Schools
- Air Conditioning
- Heating
- Inspection Work
- Gas Flowmeter
- Anywhere air or gas velocities are to be measured

The HASTINGS AIR-METER is ideal for measurement of air and gas velocities from a low of 5 feet per minute up to 6,000 feet per minute. The instrument's unique principle of operation eliminates the effect of temperature and rate of temperature change. It is not affected by normal atmospheric pressure changes. A compact unit that weighs only 24 ounces. May be operated from a 110 V, 60 cycle a-c outlet or from a battery pack.

*Adaptable to standard extension cords

ALSO THE HASTINGS PRECISION AIR-METER

Developed for field or laboratory use where extreme sensitivity and stability are required. Operates on same principle as standard Air-Meter. Easily adapted for use as a flowmeter or with remote recording or indicating instruments. Reading indicator lag is less than one second. Other special probes available. WRITE TODAY for complete data on both Air-Meters.

HASTINGS INSTRUMENT COMPANY, INC.

HAMPTON 7, VIRGINIA

DESIGNERS AND BUILDERS OF RAYDIST AND SPECIAL ELECTRONIC, ELECTRICAL, AND MECHANICAL INSTRUMENTS

WEBSTER KINETIC* BURNER

For Low Pressure Gas

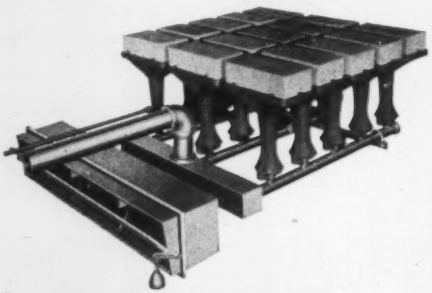
The Webster Kinetic consists of a multiplicity of full venturi mixers with flame retention nozzles. These are assembled in a metal casing complete with pilot and louvre. It may be used with natural, mixed or liquefied petroleum gases. Standby oil burners may be used when desired. As a multiple head assembly it is available in 25 standard sizes of from 4 heads to 48 heads, and can be supplied in any size or shape. Natural gas input ratings from 560,000 Btu/hr to 6,720,000 Btu/hr at 4" wc.

For complete information request Series B8 Bulletins.

●

WEBSTER SERIES F 600 BURNER

For Low Pressure Gas



Designed for LOW GAS PRESSURE
INTERCHANGEABLE PORTS
RADIANT fire brick top
NO COMBUSTION CHAMBER required
Will NOT VIBRATE
LOW draft loss
ANY SHAPE and SIZE
INTEGRALLY MOUNTED pilots

*TRADEMARK

The WEBSTER ENGINEERING COMPANY
TULSA, OKLAHOMA
Division of SURFACE COMBUSTION CORPORATION, Toledo, Ohio

W. B. CONNOR ENGINEERING CORP., New York, has appointed *HAROLD F. HAGEN* as design and engineering consultant. For over 25 years he was vice president and director of research of the B. F. Sturtevant Co., and he also has been professor of the practice of mechanical engineering, Graduate School of Engineering, Harvard University. His commercial work includes the design of the fans for the Holland tunnel, Lincoln second tube, Queens Midtown and Brooklyn-Battery tunnels.

DETROIT LUBRICATOR CO., a division of *AMERICAN RADIATOR AND STANDARD SANITARY CORP.*, has announced a number of new appointments. *F. G. COGGIN*, formerly manager, refrigeration controls div., is now assistant general manager of sales. He is succeeded in his former post by *F. Y. CARTER*, most recently chief refrigeration sales engineer. *W. H. HOHMEYER* is now manager, sales research and promotion, and the new manager, heating controls div., is *H. L. WALKER*, who replaces Mr. Hohmeyer in that position. Mr. Walker previously was assistant manager in the division. *H. LEDYARD* is now manager, industrial products div.

WARDEN N. HARTMAN has been appointed manager, industrial insulation dept., *ARMSTRONG CORK CO.*, Lancaster, Pa. Since 1948 he has been manager, contract operations dept. *JAMES W. LIDDELL* is the new manager, high-temperature insulation products, succeeding *F. W. MULLER*, who has resigned.

MAJ. GEN. THOMAS F. FARRELL, deputy administrator of the Defense Production Administration, has been appointed assistant general manager for manufacturing for the *U. S. ATOMIC ENERGY COMMISSION*. He is on military leave from his post as chairman of the New York Housing Authority. *DR. MANSON BENEDICT* has been named technical assistant to the general manager to organize an operations analysis staff for the Commission. He is on leave from Massachusetts Institute of Technology where he is professor of nuclear engineering.

ROBERT L. CORSBIE is the new chief of the civil defense liaison branch of the Commission's division of biology and medicine. He will handle liaison with the Federal Civil Defense Administration and other government and private agencies on problems having to do with effects of atomic weapons, methods of protection against atomic energy hazards, methods of treatment for radiation injuries, and methods for building structures to minimize the radiation and blast effects of atomic weapons.

A. H. BORCHARDT has been elected a vice president of *WORTHINGTON PUMP AND MACHINERY CORP.*, Harrison, N. J. He will have responsibility for the sale of the company's entire line of pumping equipment. Since 1934 he has been assistant vice president and manager, centrifugal pump application and sales div. Succeeding him as manager is *V. de P. GERBEREUX*, who has been assistant manager. *HERMAN H. MILLER* has relinquished the managership of the compressor division to act as consultant to his successor, *E. A. MURRAY*, for the next six months. Mr. Miller, who has been with the corporation for 50 years, will retire at the end of this year.

DONALD C. MINARD, for the past six years executive vice president, has been elected president of *THE TRANE CO.*, La Crosse, Wis. *RUEBEN N. TRANE*, founder and president, has been advanced to the new post of chairman of the board.

THE REFRIGERATION INDUSTRY SAFETY ADVISORY COMMITTEE, New York, elected two new officers at its recent meeting. The new chairman is *L. W. LARSEN*, sales manager, refrigeration div., Tecumseh Products Co., Tecumseh, Mich. He had been serving as treasurer. Elected treasurer was *R. L. WILLIAMS*, sales, refrigerants, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

EDGAR T. GREGORY has been named manager, flat belting sales, *B. F. GOODRICH CO.*, Akron. He succeeds *A. CLARKE MACK*, who has resigned. *DONALD E. SCHLEMMER* is the new operating manager, industrial products sales dept., replacing Mr. Gregory in that position.

HENDLEY BLACKMON has been named manager of engineering association activities for *WESTINGHOUSE ELECTRIC CORP.*, Pittsburgh. He will work with the company's engineers in the preparation of papers to be presented before engineering association meetings. Mr. Blackmon, who has served as assistant manager of the activity since 1949, succeeds *FRANK THORNTON JR.*, who recently retired.

H. E. HUMPHREYS, JR., president, *UNITED STATES RUBBER CO.*, has been elected chairman of the board of directors. He succeeds *HERBERT E. SMITH*, chairman and former president, who has retired after 38 years of service. Mr. Smith will continue as a director and member of the finance committee.

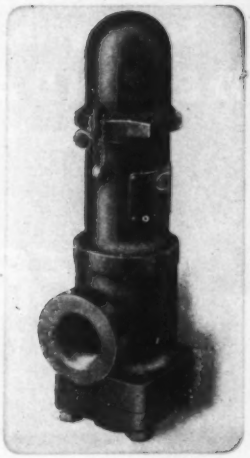
Recently appointed manager, advertising and sales promotion, *PHILIP CAREY MFG. CO.*, Cincinnati, is *L. CHARLES UNDERWOOD*, with the company since 1947, most recently as assistant advertising manager.

NORMAN PRODUCTS CO., Columbus, Ohio, has appointed *JAMES E. HUMPHREYS* as manager of the new Twinfuel div. For the past 17 years he has been business promotion manager of The Ohio Fuel Gas Co., Columbus.

ROBERT P. LONG, has been named as insulation engineer for the *KAYLO DIV., OWENS-ILLINOIS GLASS CO.*, Toledo. . . . . *DAVID S. WINICK*, formerly with the Neversink div., New York City Board of Water Supply, has joined the engineering dept. of *PARCO DESIGN CORP.*, New York.

The new sales promotion manager of *SERVEL, INC.*, Evansville, Ind., is *DAVID K. PATTERSON*, who joined the company in 1947, serving successively as copywriter, magazine editor and assistant sales promotion manager. . . . . *EUGENE A. SLOANE* has joined the advertising department of *THE TRANE CO.*, La Crosse, Wis. He will supervise three company publications. Other new members of the staff are *DAVID CORDRY, RICHARD E. GAGNE*, and *ELLEN FOWLER*.

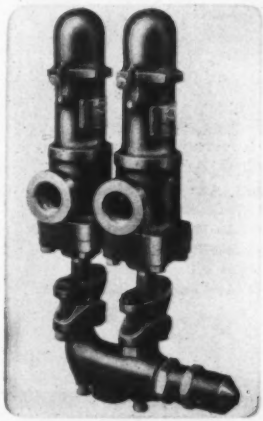
Patent Pending



Now!

A New Safety Valve, Built on a Better Principle

This improved equipment has the seat and moving parts of stainless steel; no danger of rusting fast! The parts are self-aligning and accurately made. The opening is full, giving the valve much greater capacity than earlier types.



Dual-outlet Valve Permits Re-seating and Testing Safety Valves While Refrigerating Plant is Operating

The new valve can be re-seated after it opens. It meets the requirements of the latest A.S.M.E. and A.S.A. B-9 Codes. Built in ½", ¾", 1" and 1¼" sizes.

Sensitive, dependable, and safe, this valve will give your refrigerating system the adequate protection you need.

Order today from your nearest Frick Branch or Distributor, or direct from

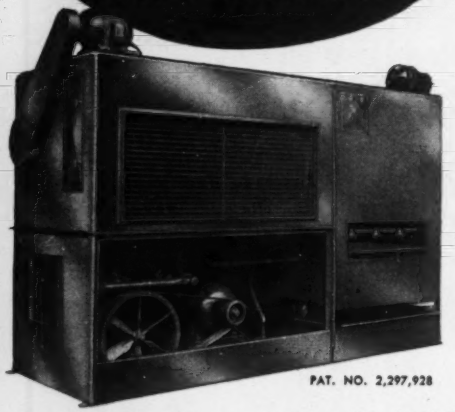
DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.

Also Builders of Power Farming and Sawmill Machinery

For day in, day out
DEPENDABILITY
you can't beat a
GOVERNAIR
COMPLETELY PACKAGED
AIR CONDITIONER



PAT. NO. 2,297,928

Name your job . . . any air conditioning job requiring from 3 to 50 tons . . . and you'll find that you can't beat a Governair system for day in, day out dependability.

Governair Packaged Air Conditioners are designed to operate at peak efficiency—with all parts precision-matched to work together. And they're built to give years and years of low-cost, trouble-free service.

Choose Governair . . . and you choose the best!

AIR CONDITIONERS | EVAPORATIVE CONDENSERS | COOLING TOWERS | UNIT COOLERS | BLAST COILS FOR HEATING AND COOLING

GOVERNAIR

DR. EDWARD U. CONDON, noted nuclear physicist, has been appointed director of research and development for *CORNING GLASS WORKS.*, Corning, N. Y. He has resigned (effective September 30) as director of the National Bureau of Standards in Washington, D.C. *DR. JESSE T. LITTLETON*, vice president and present director of research, will become general technical advisor.

Three engineering executives, *BRUCE R. WRIGHT, JOHN T. ODBERT* and *MICHAEL J. TOTH* have joined the steam specialty div., *V. D. ANDERSON CO.*, Cleveland. They will aid in the development of new purifiers.

W. H. MAXWELL is now assistant to the vice president, *WOLVERINE TUBE DIV., CALUMET & HECLA CONSOLIDATED COPPER CO., INC.*, Detroit. Formerly director of sales for the division, he has moved to Washington, D.C., where he will work with government control agencies.

A. M. NORRIS, recently associated with Lloyd E. Mitchell, Inc., as chief air conditioning engineer, has joined *BALTIMORE AIRCOIL CO., INC.*, as chief engineer. Mr. Norris is well known for his psychrograph, an advanced form of psychrometric chart, which he developed in 1931.

M. W. TOWNSEND is the new director of sales for *HANDY & HARMAN*, New York, covering all products used in the arts and industrial fields. For five years he has been assistant to the vice president in charge of sales . . . . . *J. M. MACKAY* has been elected director, executive vice president, and general manager of *IRON FIREMAN MFG. CO. OF CANADA LTD.*, an Iron Fireman subsidiary at Toronto. Before his election he was plant manager at Toronto.

At its 103rd commencement, *GENEVA COLLEGE*, Beaver Falls, Pa., awarded the honorary degree of Doctor of Laws to *LUKE E. SAWYER*, president, Babcock & Wilcox Tube Co., Beaver Falls. . . . . *RUEBEN N. TRANE*, chairman of the board, Trane Co., La Crosse, Wis., recently received a special citation from the *UNIVERSITY OF WISCONSIN* for his "many significant contributions to development of better living conditions." It was presented by the president of the University at a special convocation.

. . . IN THE TERRITORIES

For *DETROIT LUBRICATOR CO.*, div. of *AMERICAN RADIATOR AND STANDARD SANITARY CORP.* — three new sales appointments. *K. B. THORNDIKE*, previously in charge of the western regional office, Chicago, is now vice president in charge of the eastern regional office, New York. The new manager of the west central regional office, Chicago, is *T. C. McKEE, JR.*, and *F. J. KREISSL* is managing the east central regional office, Pittsburgh.

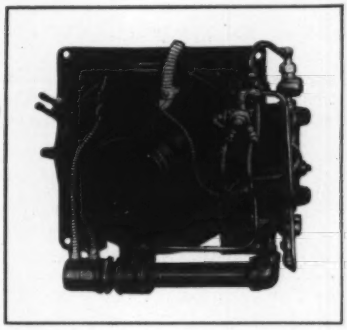
For *UNITED STATES AIR CONDITIONING CORP.*, Minneapolis — a new exclusive distributor, *WESTINGHOUSE ELECTRIC SUPPLY CO.*, with offices in Long Island City and Newark. The firm will handle room air

For the **BIG** *heating jobs...*

there's nothing to equal the world famous

JOHNSON 30 AVH

PERFECT for HOTELS, HOSPITALS, OFFICE BUILDINGS
***and countless other* HEAVY DUTY HEATING JOBS**



Johnson's time-tested 30 AVH Burner uses preheated heavy oils that keep fuel bills low. It is built in six sizes and capacities to meet virtually any heavy-duty heating need.

For all around efficiency and fuel economy, the Johnson 30 AVH has never been surpassed. Heating Engineers all over the world have learned from actual experience that they can depend on 30 AVH performance. Probably more big buildings have been heated for more years by 30 AVH Burners than by any other single oil burner model ever built. With complete confidence, we recommend it for your consideration on any heavy-duty job.

If the 30 AVH doesn't fit your specifications, there are other fine Johnson Burners that will. For the Johnson line-up is a *complete* line-up; small "packaged" domestic heating units . . . water heaters of every size . . . air, steam and hot water units . . . and a wide assortment of heavy-duty burners. Tell us what you need. We can supply it, and we'll be glad to help.

There's a Johnson Oil Burner for every heating need

Johnson Oil Burners

S. T. JOHNSON CO.
940 Arlington Ave., Oakland 8, Calif.
401 No. Broad St., Philadelphia 8, Pa.

OVER $1000 FUEL SAVINGS PER YEAR WITH PERFEX INDUSTRIAL CONTROLS

PERFEX CORPORATION, MILWAUKEE, WISCONSIN
In Canada, Perfex Controls Ltd., Toronto 1, Canada

"It's true! Now, with efficient and dependable boiler equipment we are no longer troubled with excessive smoke. Fuel savings *alone* have paid for our PERFEX Controls and Instruments in less than one year...And that does not include the extra savings on maintenance. Best of all, we'll be saving money for years to come...thanks to PERFEX Controls."

I. B. Fort, Chief Engineer, Friendship Laundry Service, Chicago, Illinois.

CONSERVE FUEL • INCREASE EFFICIENCY
SAVE TIME! • SAVE MONEY!

WITHOUT OBLIGATION CLIP AND MAIL TODAY!

PERFEX CORPORATION
500 West Oklahoma Avenue • Milwaukee 7, Wisconsin

Send me more information on Perfex equipment for my boiler room.

Name_____

Address_____

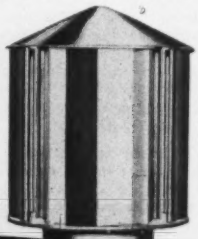
City_____

State_____

When you consider VENTILATORS

Ask for PROOF OF PERFORMANCE!

Claims are a dime a dozen in the ventilating field. The only way to be *sure* of what you're buying in *any* make of ventilator is to insist on certified capacity ratings derived from tests made with the wind blowing against the ventilator in *all* directions as shown below. True performance under actual operating conditions can be determined only by such tests!



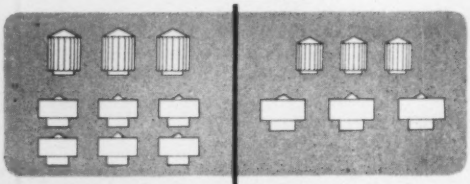
Patent No. 2269428

Breidert Air-X-Hausters

give you CERTIFIED and Published Capacity Ratings

Breidert ratings *are* based on tests made with wind blowing in all directions.* No matter which way the wind blows, barring interior negative pressures, the Breidert provides safe, sure ventilation . . . on roofs, vent flues, chimney tops. Stationary, no moving parts, nothing to jam or get out of order

HOW YOU CAN GET BETTER RESULTS WITH LESS MONEY



It takes fewer Breiderts to do the job as same size conventional ventilators.

(or)

You can use the same number of smaller size Breiderts to do the same job as conventional ventilators.

Get *all* the facts! Write today for complete Engineering Data Book, including certified capacity ratings. Address Dept. A.

**By Pittsburgh Testing Laboratories*

THE G. C. BREIDERT CO.

3129 San Fernando Road, Los Angeles 65, Calif.

Representatives in principal cities throughout the U.S.

conditioners in the metropolitan New York and northern New Jersey areas. Sales will be directed by *HARRY LaGUE*, Long Island City. *SOUTHERN HEATER CO., INC.*, New Orleans, which distributes the corporation's gas fired unit heaters, has opened a branch sales room and warehouse at 1482 Madison Ave., Memphis, to serve the western Tennessee and Arkansas areas. The manager is *A. J. SAUCIER*.

For the New York office of *DOW CORNING CORP.*, Midland, Mich.—a new location at 600 5th Ave. ..... The Detroit branch offices of *NIAGARA MACHINE & TOOL WORKS* have been moved from the General Motors Building to larger quarters at 15484 James Couzens Highway.

For *CONOFLOW CORP.*, Philadelphia—two new representatives to extend the company's field service to the Houston, Tex., and Pittsburgh, Pa. areas. *HAROLD G. JONES CO.*, 502 Empire Bldg., Pittsburgh will cover the Pittsburgh, western Pennsylvania and northwestern West Virginia territories. *M. N. AITKEN CO.*, 5960 Kansas St., Houston, will cover Houston and the surrounding area extending from Freeport to Lake Charles, La.

For *BALTIMORE AIRCOIL CO., INC.*—three new representatives. *H. L. McMURRY & CO.*, with offices in Jacksonville, Miami, and Tampa, is exclusive representative in Florida. *BRYNER-SPRANLEY*, 5701 Canal Blvd., New Orleans, will handle Louisiana, exclusive of the Shreveport area. *HUMPHREY-WYNNE CO.*, 620 Sterick Bldg., Memphis, will cover western Tennessee and northeastern Arkansas.

For *JENKINS BROS.*, New York—*HOWARD J. DAUPHINEE*, appointed to the valve sales staff, will cover the northern California territory, working out of the San Francisco office. Previously, he headed export sales for the Enterprise Engine & Machinery Co.

For *KAYLO DIV., OWENS-ILLINOIS GLASS CO.*, Toledo—a new sales engineer, *ANTHONY J. TYSENN*, assigned to the Philadelphia office. He replaces *H. L. PICKEL*, who recently left the company to start his own business.

For *TRANE CO.*, La Crosse, Wis.—three new branch office appointments. *R. S. OYER*, formerly with the Johnson Service Co., is now manager of the New Orleans office. *MARVIN R. CLEMONS* has joined the New Orleans office as a field representative. Previously he was associated with Walter Cooke, manufacturers' representative in the area. *E. M. JAMESON*, a company field representative for the last two years, is the new manager of the Oklahoma City office. He succeeds *R. W. SCHULTE* who died recently.

For *ACME INDUSTRIES, INC.*, Jackson, Mich.—a newly appointed regional sales manager, *ROBERT T. HANSEN*, who will cover the central states area. His headquarters will be Chicago.

For *GLOBE STEEL TUBES CO.*, Milwaukee—a new distributor, *THE SMITH PIPE AND STEEL CO.*, Phoenix, Ariz., which will handle the company's complete line of welding fittings.

For *THE NATIONAL RADIATOR CO.*, Johnstown, Pa.—the western Pennsylvania, eastern Ohio and northern West Virginia territories will be handled by *JAMES L. WOMER*, a member of the Chicago branch sales staff until March, when he was transferred to Pittsburgh. He succeeds *CHARLES F. MORROW*, who has retired from the company after completing 43 years of service.

For *GENERAL CONTROLS CO.*, Glendale, Calif.—*S. D. ANDREWS*, who joined the company three years ago, is the new branch manager of the Dallas, Tex., office. He replaces *ROBERT FARMER* who returns to the Glendale plant as a factory engineer.

For *DRAVO CORP.*, Pittsburgh—*JOHN T. EDELEN* has been appointed sales engineer in the Cincinnati office of the machinery division. He was assigned to the Kentucky area, including Louisville and certain areas in southern Ohio. Mr. Edelen also will represent the De Laval Steam Turbine Co.; C. H. Wheeler Div., Hamilton Thomas Co.; and Walker Process Equipment, Inc.

For *ACME INDUSTRIES, INC.*, Jackson, Mich.—*VERNON TUPPER, JR.*, is the new southern regional sales manager. Until May, 1951, he was president and supervisor of sales in the eastern half of the U. S. for the Bal-Air Corp. Mr. Tupper replaces *WILLIAM FUNK* who has been transferred to Philadelphia where he will be eastern regional sales manager.

For *TRUMBULL ELECTRIC*, department of *GENERAL ELECTRIC CO.*, Plainville, Conn.—*DOUGLAS J. DONOHUE*, since 1945 salesman for its eastern territory, has been appointed Atlantic district sales manager. He will maintain his office in Philadelphia.

For *TIMKEN SILENT AUTOMATIC DIV.*, Timken-Detroit Axle Co.—*ROBERT D. HOWLAND* has been appointed field service representative. He will begin work in Michigan, and eventually will be in the Wisconsin region.

For *WORTHINGTON PUMP AND MACHINERY CORP.*, Harrison, N.J.—a new branch office in Harrisburg, Pa., at 506 Hall Building, 2nd and Locust Sts. *A. L. MAYS* will be in charge of the new office, which will be a branch of the company's Philadelphia office.

For *RELIANCE ELECTRIC & ENGINEERING CO.*, Cleveland—*LLOYD F. GIEGEL* has been appointed branch manager of the Gary, Ind., sales office. *DANIEL J. DONNELLY* is a new sales engineer in the company's Philadelphia office. . . . . The *KITSON DIV., WELSBACH CORP.*, valve manufacturer, has appointed *J. R. WILLIAMS*, Dublin, O., as its representative in western Ohio.

HOW TO GET QUICK INFORMATION on THERM-O-TILE

Reg. U. S. Pat. Off.

UNDERGROUND STEAM CONDUIT

N.E. UNITED STATES

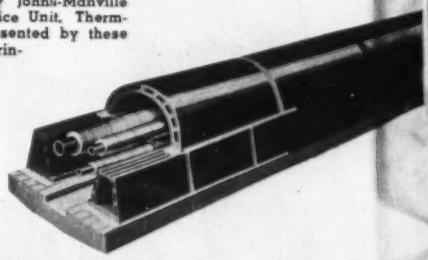
Telephone H. W. Porter & Co., Newark, N.J., as printed below. Engineers with many years of successful insulation experience will give your call prompt and thorough attention.

S.E. UNITED STATES

Telephone the nearest Reid Hayden office, as printed below — Baltimore, Richmond, or Charlotte. Capable engineers in these offices have been installing Therm-O-Tile in the Southern States ever since it was first placed on the market.

ELSEWHERE

Telephone any Johns-Manville Technical Service Unit. Therm-O-Tile is represented by these units in all principal cities.



THERM-O-TILE BULLETIN 511

This bulletin, just recently published, gives complete data concerning Therm-O-Tile. Read it and you will understand why Therm-O-Tile was chosen for the first Federal Housing Project and since then in many other large projects including First Prize Glen Oaks Village, New York City. See our advertisements in the journal during past years for a better understanding of Therm-O-Tile acceptance by heating specialists. A copy of 511 is yours for the asking.

H. W. PORTER & CO., INC.

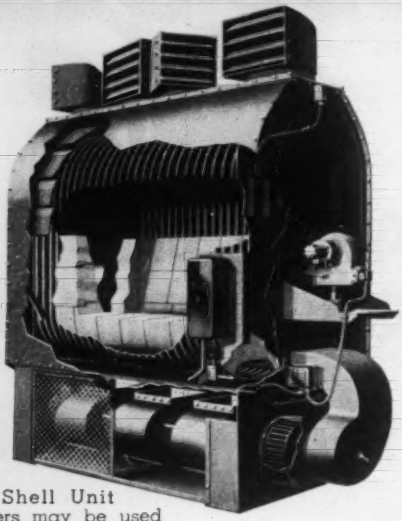
922-H Frelinghuysen Avenue • Newark 5, N. J.

REID HAYDEN, INC.

BALTIMORE, MD. RICHMOND, VA. CHARLOTTE, N. C.

Insulation Engineers & Contractors

LEE SHELL UNIT HEATER



Lee Shell Unit Heaters may be used singly or as a central system with the heated air distributed through ducts.
The efficiency of Lee Counter-current flow reduces fuel consumption while the rugged simplicity of the system decreases cost of installation, assures low maintenance charges and provides ventilation without additional cost.

The LEE line . . .
Steel Encased Tubular Heater
Tubular Unit Heater
Brick-Set Tubular Heater
Shell Unit Heater
Write now for more information

LEE CORPORATION
1001 TATNALL STREET
WILMINGTON, DELAWARE

NEW BOOKS & REPORTS

ASTM Issues 1950 Supplements to its Book of Standards

To keep its triennially published *Book of ASTM Standards* up to date, the American Society for Testing Materials in the intervening years issues supplements to each part of the book. The 1950 supplements, recently issued in six parts, give in their latest approved form 353 specifications, tests and definitions which were either issued for the first time in 1950 or revised since their appearance in the 1949 book.

Part 1 — *Ferrous Metals* (328 pages) includes 66 standards covering steel (pipe and tubes, welding fittings, castings, bolting material, boiler plates, structural and rivet steel, bar steels, forgings, heat treated tires and springs, concrete reinforcement steel, corrosion and heat resisting steels, and metallic coated steel products); cast iron and malleable iron; ferro-alloys; metallography; and general testing methods.

Part 2 — *Non-Ferrous Metals* (232 pages) includes 42 standards covering copper and copper-base alloys (wire, rods and stranded conductors for electrical purposes, plate, sheet and strip, bars, shapes, pipe and tubes); aluminum and copper wire, rods and stranded conductors; aluminum and aluminum-base alloys; die-cast metals and alloys; electrical-heating, resistance, and related alloys (including electrical furnace alloys, and thermostat metals); metal powders and metal powder products; and general testing methods.

Part 5 — *Textiles, Soap, Fuels, Petroleum, Aromatic Hydrocarbons, Antifreezes, Water* (596 pages) includes 93 standards covering textiles; soaps; coke; petroleum products and lubricants (motor and aviation fuels, light hydrocarbons, diesel fuels, hydrocarbon liquid solvents, distillate burner fuels, kerosene, illuminating, turbine and electrical insulating oils); greases; methods of measuring and sampling petroleum and its products; industrial aromatic hydrocarbons; gaseous fuels; industrial water (analytical methods, corrosivity tests, etc.); thermometers; and general testing methods.

The other supplements are: *Part* 3 — *Cement, Concrete, Ceramics, Thermal Insulation, Road Materials, Waterproofing Soils* (364 pages) which includes some standards on thermal insulating materials; *Part* 4 — *Paint, Naval Stores, Wood, Adhesives, Paper, Shipping Containers* (352 pages) and *Part* 6 — *Electrical Insulation, Plastics, Rubber.*

The supplements, in heavy paper cover, can be obtained from the society at 1916 Race St., Philadelphia 3, for $3.50 each.

Mechanics of Vibration and Shock Isolation Explained

A new book on the protection of equipment and machinery by the use of resilient supports, *Vibration and Shock Isolation*, by Charles E. Crede, has been published by John Wiley and Sons, Inc. The author, now vice president and chief engineer for The Barry Corp., Watertown, Mass., bases his discussion on years of work with vibration and isolators for the Navy Department. The

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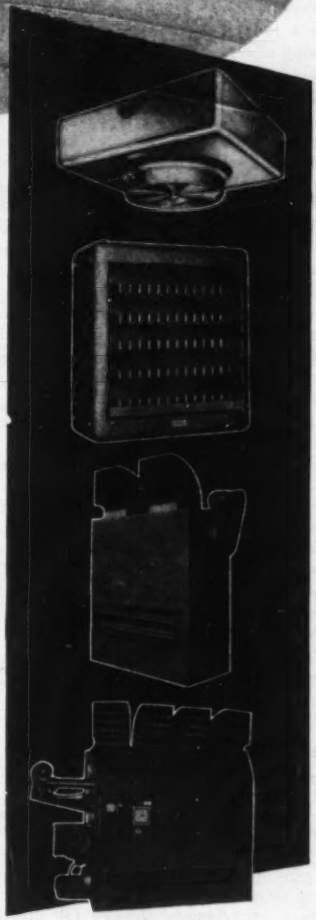

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book analyzes the causes of vibration and shock and evaluates the use of natural and synthetic rubbers, metal springs, felt and cork for designing isolators. Sections are devoted to special applications of isolators (in machinery such as punch presses, electric motors, military equipment, etc.).

The 328 page book may be obtained from the publisher at 440 4th Ave., New York 16, for $6.50 a copy.

Information on Summer and Winter Air Conditioning Expanded in Second Edition

Psychrometric principles, the physiology of comfort, and a general description of various types of air conditioning systems comprise the first chapters of *Air Conditioning in Summer and Winter*, by Richard E. Holmes.

The author discusses summer and winter conditioning loads, advantages and disadvantages of various heating and refrigerating systems, and the application of diverse air conditioning methods and equipment (air filters, humidifiers, condensing equipment, self contained conditioners, and temperature and humidity controls).

The book is intended to give engineers and students with secondary school technical education a general grounding in the field. It consists of the rewritten and expanded lessons given to air conditioning students at Westinghouse Electric Corp. by the author, now chief engineer, Air Conditioning Div., Worthington Pump and Machinery Corp., and instructor, Northeastern University. Each chapter is followed by a series of relevant questions and problems for the student.

In the new edition, the material has been revised to bring up to date all procedures, tabular data, descriptions and illustrations. The chapter on refrigeration systems now presents an analysis of the cycle of operation on the pressure-enthalpy diagram, where the effects of the design of the various components upon the efficiency of the system may be demonstrated. A discussion of the reverse-cycle system has been added, and material on absorption systems has been expanded. A new chapter has been written on the design principles of reciprocating and centrifugal compressors,

This 352 page book is available from the publisher, McGraw-Hill Book Co., 330 W. 42nd St., New York 18, at $5.75 a copy.

Reports Uses of Low Dust Concentration Measuring Methods

Report of investigations 4782, *Investigation of a Photoelectric Device for the Determination of Low Concentrations of Dust*, by D. I. Stone, L. J. Kane, T. E. Corrigan, H. W. Wainwright, and C. B. Seibert, discusses new low dust concentration measuring methods and their use in testing experimental devices for protecting compression machinery from low dust concentrations.

A limited number of copies are available without charge from the publications distribution section, Bureau of Mines, 4800 Forbes St., Pittsburgh 13. The report, as PB 103 260 (same title), can be obtained from the Library of Congress, photoduplication service, publication board project, Washington 25, D.C., at $1.75 in microfilm or $2.50 in photostat.

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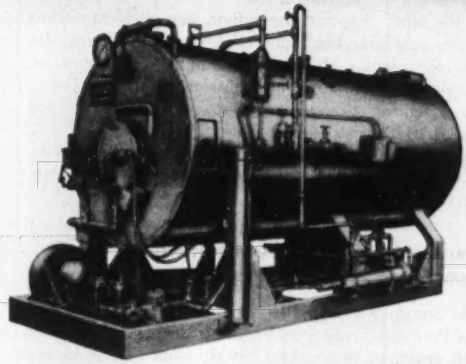

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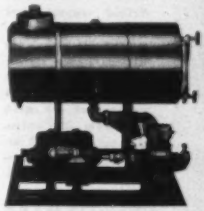

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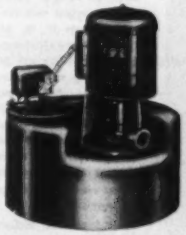

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Meters and Measurements Treated in New Book on Electricity and Magnetism

Included in the new book, *Practical Electricity and Magnetism,* by Maurice Rubin, is a chapter on electrical meters and measurements which covers such topics as the ammeter, use and principle of the shunt, the voltmeter and its connections, use and principle of the multiplier, potential drop, the wattmeter, resistance measurements, measurement of inductance, etc.

In the other chapters, the author, now resident-visiting engineer on radar for Bell Telephone Laboratories, discusses electrostatics, electric charges in motion, magnetism, photo-electric and thermionic emission, electrical conductivity of gases, practical applications (generators and motors), and recent developments in the field.

This 356 page book may be obtained from the publisher, The Chemical Publishing Co., Inc., 212 5th Ave., New York 10, at $7.50 a copy.

Paper Discusses Building Construction in Relation to Solar Heat Gains

The Sunshine Problem in Air Conditioning, the Napier Shaw Premium Lecture delivered by Neville S. Billington, which appeared in the June, 1951, issue of the Journal of the Institution of Heating and Ventilating Engineers, is a consideration of building construction as it is related to solar heat gains. Surface treatments used for excluding the sun's heat are touched on. Solar heat gain through walls and roofs and the effect of internal partitions and furniture are discussed. The conclusion is that the external wall construction has a relatively small effect on conditions within a building fully exposed to the sun.

The Journal is published by the Institution, 75 Eaton Place, London S.W.1, England.

New Volume Brings Together Practical Information on Industrial Piping

Steam piping, valves, water piping, oil piping and the Fanning formula, alloy piping, and similar topics are covered in the new book, *Industrial Piping,* by Charles T. Littleton, which is intended for practising piping designers and erection foremen as well as engineering students. This 394 page book may be obtained from the publisher, McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, at $8.00 a copy. It will be reviewed fully in a later issue of Heating, Piping & Air Conditioning.

Other Books and Reports Received

THE HUMAN SIDE OF INDUSTRY—This new 102 page booklet comprises the transactions of the 15th annual meeting of the Industrial Hygiene Foundation of America, Inc. (Mellon Institute). The title article is the speech delivered by D. K. David, Dean, Graduate School of Business Administration, Harvard University. Also included are a panel discussion on "Teamwork for a Better Workplace," and articles on auditing industry's medical departments (facilities and administration), the cost of employee disability to the employer, and protection of personnel and plants in an atomic emergency.

The booklet, transactions bulletin no. 15, was published by the foundation, 4400 5th Ave., Pittsburgh 13.

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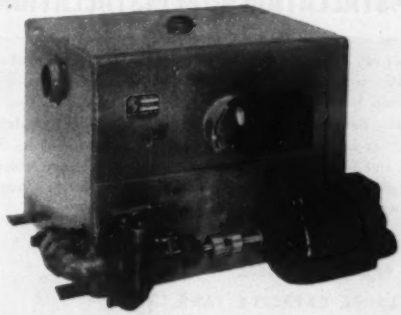

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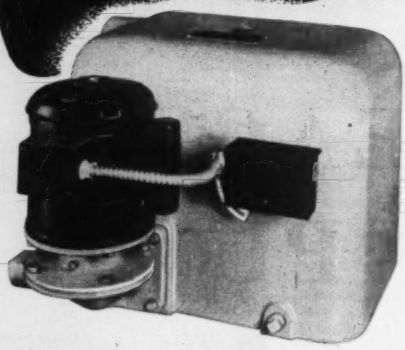

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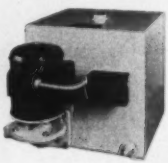

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MEETINGS & CONVENTIONS

6th NATIONAL INSTRUMENT CONFERENCE AND EXHIBIT—Sponsored by the Instrument Society of America, 921 Ridge Ave., Pittsburgh 12. The affair will be held in the Sam Houston Coliseum, Houston, Tex., September 10 to 14.

INTERNATIONAL DISCUSSION OF HEAT TRANSFER—Postwar heat transfer developments will be the theme of a meeting, September 11 to 13, London, England. Plans for participation by engineers in the western hemisphere are being arranged by a joint committee on North American participation, which consists of representatives from some 12 professional and engineering societies. The American Society of Mechanical Engineers, 29 W. 39th St., New York 18, is coordinating administrative details.

IBR SCHOOL OF MODERN HEATING—The school of modern heating, sponsored by the Institute of Boiler and Radiator Manufacturers, 60 E. 42nd St., New York 17, is a travelling school designed to provide an intensive three-day training in heating design and installation. Classes will be held this month from September 11 to 13, at Grand Rapids, Mich.; from September 18 to 20, at Minneapolis, Minn.; and from September 25 to 27, at Omaha, Neb. A list of the dates and locations of meetings to be held through December of this year is now available from the institute.

BRITISH BUILDING RESEARCH CONGRESS—Sponsored by a number of professional institutions and societies, government departments, and representative industrial federations, the congress will be held in London, September 11 to 20.

Among the papers to be presented during the heating and ventilating sessions is one on heat transfer, by Prof. C. O. Mackey, Cornell University, and one on radiant heating by Prof. F. W. Hutchinson, University of California.

WHOLESALE HEATING AND PLUMBING TRADES OF NEW ENGLAND—The annual convention will be held Sepetmber 14 to 17 at The Balsams, Dixville Notch, N. H.

1951 PUBLIC WORKS CONGRESS AND EQUIPMENT SHOW—The congress and show, sponsored by the American Public Works Association, 1313 E. 60th St., Chicago 37, will be held September 16 to 19 at Veterans Memorial Bldg., Detroit, Mich.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39th St., New York 18—The fall meeting will be held September 26 to 28 at the Hotel Radisson, Minneapolis. Papers scheduled for the meeting include:

Distribution of Heat Transfer Coefficients around Circular Cylinders in Cross Flow at Reynolds Numbers from 20 to 500, by E. R. G. Eckert, National Advisory Committee for Aeronautics, and Eric Soehngen, U.S.A.F. Office of Air Research.

Determination of Dust Concentrations in Flour Mill Suction Systems, by John M. MacKenzie, U. of Minnesota.

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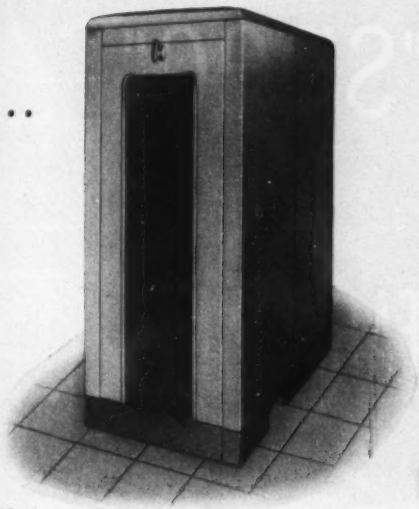

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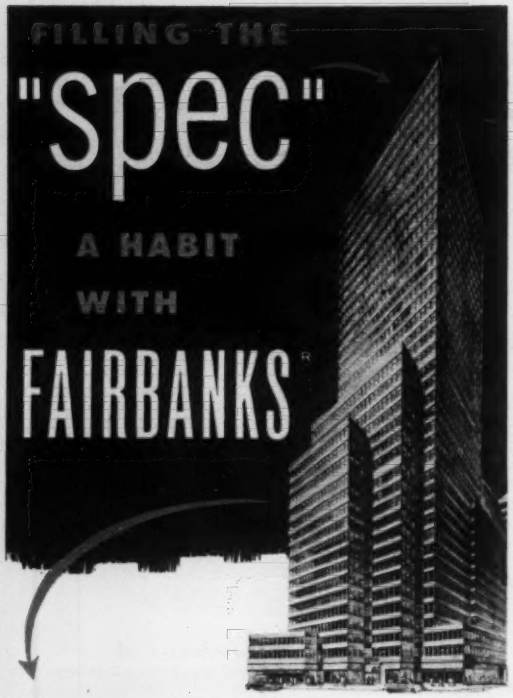

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Measurement of Particle Size Distribution in Flour, by Kenneth T. Whitby, U. of Minnesota.

Industrial Plant Boiler Feedwater Treatment, by D. C. Carmichael, E. I. DuPont de Nemours & Co.

An Experimental Investigation of Overstraining in Mild Steel Thick-Walled Cylinders by Internal Fluid Pressure, by Montgomerie C. Steele and John Young, U. of Illinois.

Some Theoretical Aerodynamic Investigations of Impellers in Radial and Mixed Flow Centrifugal Compressors, by John D. Stanitz, National Advisory Committee for Aeronautics.

39th NATIONAL SAFETY CONGRESS AND EXPOSITION—to be held in Chicago, October 8 to 12. Sessions on industrial safety are scheduled for the Stevens, Palmer House, Congress and Morrison hotels. For further information write R. L. Forney, general secretary, National Safety Council, 425 N. Michigan Ave., Chicago 11.

14th JOINT FUELS CONFERENCE—Sponsored by the Coal Division, American Institute of Mining and Metallurgical Engineers, 29 W. 39th St., New York 18, and the Fuels Division, American Society of Mechanical Engineers (same address), the conference will be held October 11 and 12, at the Roanoke Hotel, Roanoke, Va.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 500 5th Ave., New York 16—A technical conference on the application of fractional horsepower motors to refrigeration equipment and pumps has been scheduled by the Institute for October 11 and 12, at the Dayton Biltmore Hotel, Dayton, Ohio. For information regarding registration, etc., write D. C. Breeding, Frigidaire Div., General Motors Corp., Dayton, Ohio.

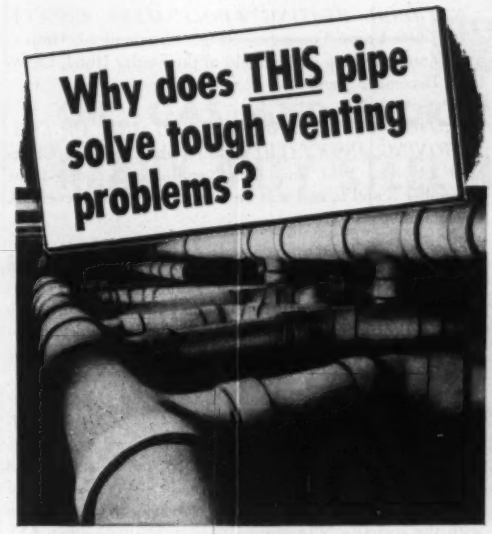
AMERICAN GAS ASSOCIATION, 420 Lexington Ave., New York City—The 33rd annual convention, St. Louis, October 15 to 17. The Jefferson hotel will be headquarters for the residential gas and industrial and commercial gas sections; the Mayfair and Lennox hotels for the operating section; and the Statler Hotel will house the accounting section.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS, 919 Milam Bldg., Houston 2, Tex.—The annual meeting of the association's South Central Region is scheduled for October 18 to 20, at Corpus Christi, Tex.

PLUMBING AND HEATING INDUSTRIES BUREAU, 35 E. Wacker Drive, Chicago 1—The annual meeting will be held at the Palmer House, Chicago, October 25.

THE 7th ALL-INDUSTRY REFRIGERATION AND AIR CONDITIONING EXPOSITION, to be held at Navy Pier, Chicago, November 5 to 8. The affair is sponsored by the Refrigeration Equipment Manufacturers Association, 1346 Connecticut Ave., N.W., Washington 6, D. C.

CONFERENCE ON DESIGN AND CONSTRUCTION OF ATOMIC INSTALLATIONS—Co-sponsored by the American Institute of Architects, 1741 New York Ave., Washington 6, D.C., and the U.S. Atomic Energy Commission, Washington 25, D.C., the conference will be conducted by the Building Research Advisory Board of the National Research Council. It will be held November 27 and 28 in Washington, D. C. Discussions of atomic age architecture are planned.



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This tough, durable asbestos-cement pipe successfully resists many of the corrosive fumes, vapors, and gases encountered in a wide variety of industrial operations... helps avoid frequent replacements that waste both time and money.

In addition, Transite Industrial Vent Pipe is nonmetallic and therefore rustproof—needs no painting or other protective treatment. It can be used as ducts, vents or stacks in either indoor or outdoor service.

Plant men appreciate its light weight, plus the fact that it can be cut and drilled with ordinary tools. And it comes in a complete range of sizes up to 36" in diameter . . . with a complete line of rustproof, corrosion-resistant fittings that adapt it to practically any job requirement.

You will find further details on Transite Industrial Vent Pipe in Data Sheet Series DS-336. For your copy write Johns-Manville, Box 290, New York 16, N. Y. In Canada, 199 Bay Street, Toronto, Ontario.

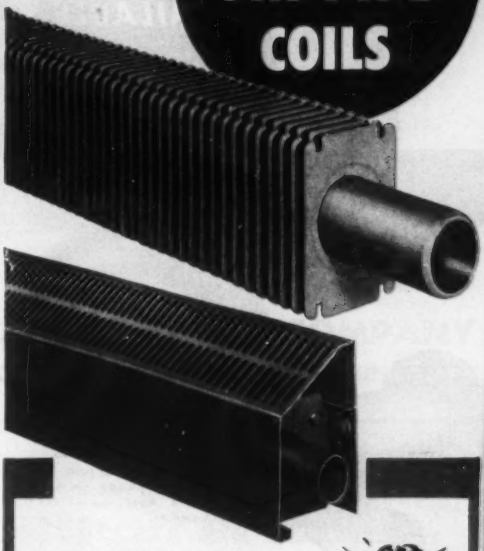
*Transite is a registered Johns-Manville trade mark.

Johns-Manville
TRANSITE Industrial Vent PIPE

Truly modern heating at lowest cost

...for Schools, Hospitals, Hotels, Industrial Plants, Commercial and Apartment Buildings

KRITZER *Commercial* "FIN PIPE" COILS



Team up with KRITZER...

Kritzer takes all the guesswork out of finned-pipe heating. Figuring a job is easy, and *sure* — thanks to authoritative test-based performance tables, and greater standardization among component parts. Installation is simple as ABC. One job will convince you that "If it's Kritzer it's right, Sir!" — right for the job, and right for *you*. Write for all the facts on Kritzer Commercial Fin-Pipe Coils today.

Heating Engineers — Kritzer Engineering Manuals offer the most complete data available on finned-pipe heating; write for copies.

See your Jobber for Kritzer Radiant Coils.

KRITZER RADIANT COILS, INC.
2901 W. Lawrence Ave., Chicago 25, Ill.

SAVE CRITICAL MATERIALS

CUT PIPING COSTS...

with Zephyrweld® Stainless Steel

SCHEDULE 5 and 10 WELDING FITTINGS

NOW AVAILABLE

in I.P.S. and TUBE O.D. sizes from the Complete TRI-CLOVER LINE

In addition to standard fitting types, Tri-Clover offers a wide range of prefabricated assemblies such as this butt-welded, flanged unit, to meet special requirements.

• Here is your chance to save on critical corrosion-resistant materials—and cut your piping costs at the same time . . . with Zephyrweld® SS Schedule 5 and 10 light weight welding fittings.

Fabricated in a full range of fitting types, in both I.P.S. and TUBE O.D. sizes from ½ in. thru 24 in., these fittings are now available from Tri-Clover's Complete Line of corrosion-resistant fittings, valves, pumps, pipe, tubing and specialties. Stocks are also carried in strategically located warehouses throughout the country.

Tri-Clover® MACHINE CO. Kenosha, Wisconsin

TRIALLOY AND STAINLESS STEEL SANITARY FITTINGS, VALVES, PUMPS, TUBING, SPECIALTIES — TRI-CLOVER — FABRICATED STAINLESS STEEL INDUSTRIAL FITTINGS AND INDUSTRIAL PUMPS

THE Complete LINE

SEND FOR NEW CATALOG

Catalog 1051 is now available, containing complete descriptive data on the full line of Tri-Clover Schedule 5 and 10 Fittings. Send for your copy today.

NATIONAL HEATING WHOLESALERS ASSOCIATION, 609 Union Commerce Bldg., Cleveland 14, Ohio—The annual meeting will be held at the Statler Hotel, Cleveland, December 3 and 4.

NATIONAL WARM AIR HEATING AND AIR CONDITIONING ASSOCIATION, 145 Public Square, Cleveland 14—The 1951 annual convention is scheduled for December 5 and 6, and will be held at the Hotel Cleveland, Cleveland.

THIRD PLANT MAINTENANCE SHOW—To be held at Convention Hall, Philadelphia, January 14 to 17. Registration and hotel information may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York, the exposition management. An exhibitors' list is available from Banner & Greif, 250 W. 57th St., New York 19.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, 51 Madison Ave., New York—The 58th annual meeting will be held in St. Louis, January 28 to 30. The next International Heating, Ventilating and Air Conditioning Exposition will be held in conjunction with the society's 59th annual meeting, to be held in Chicago, January, 1953.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS, 919 Milam Bldg., Houston, Tex.—The 1952 annual conference will be held at Galveston, Tex., March 10 to 14.

INTERNATIONAL CHURCHMAN'S EXPOSITION—The first annual exposition is scheduled for the Chicago International Amphitheatre for May 19 to 24, 1952. It is designed to aid churches of all faiths in the planning, construction, maintenance and the more effective use of church property. Further information may be obtained from M. W. Hinson and J. Vancil, exposition managers, 19 South LaSalle St., Chicago 3.

New Book Offers Information on Aircraft Air Conditioning

Air Systems for Aircraft, by C. A. H. Pollitt, describes the construction and operation of the various pneumatic operating systems used in civil and military aircraft.

There is a chapter on air conditioning and cabin heating systems which covers inflatable pressure cabin seals, the Barber-Colman micro cabin temperature control system, warm air cabin heating systems for non-pressurized cabins, cabin heating systems for pressurized cabins (using petrol heaters), for non-pressurized cabins (using petrol heaters), petrol heaters for cabin heating, the Stewart-Warner "South-wind" injection type hermetic combustion heater, fluid heat aircraft heaters, and similar equipment.

Another chapter covers the Minneapolis-Honeywell cabin temperature control system for the Douglas DC-4 "Skymaster" aircraft.

Also discussed are superchargers and other engine controls, pneumatic radiator flap controls, brake systems, etc.

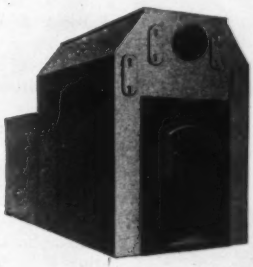
This 176 page book, published by Sir Isaac Pitman & Sons, Ltd., London, may be obtained from the distributor, Pitman Publishing Corp., 2 W. 45th St., New York 19, at $4.75 a copy.

NATIONAL CHAMPION

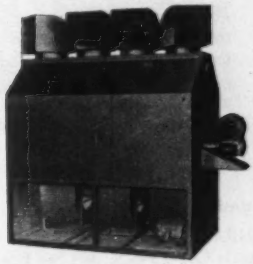
OIL, GAS AND STOKER FIRED
HEAVY DUTY STEEL HEATERS

AVAILABLE
WITH OR WITHOUT
INDUCED DRAFT BLOWERS

MODEL D
200,000 TO 1,500,000 BTU



900 SERIES
400,000 TO 2,000,000 BTU



MODEL H
200,000 TO 1,500,000 BTU

Ideal for:

AUDITORIUMS	CHURCHES
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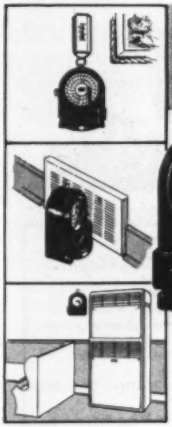
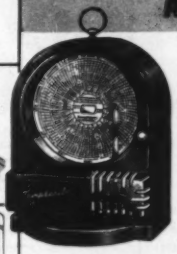
NATIONAL HEATER COMPANY

2180 CLEORA AVE. ST. PAUL 4, MINNESOTA



SERVICE Instruments for Measuring AIR TEMPERATURE and AIR VELOCITY



TEMPSCRIBE
Recording Thermometer

Available in 10 different ranges to cover −30°F to +160°F temperatures, and with spring-operated chart drives for any of the following chart rotations: 8 hours, 24 hours or 7 days.

This entirely self-contained, compact and reliable temperature recorder automatically writes a continuous record of temperature changes on a replaceable chart. Record shows at a glance maximum and minimum temperatures and the duration of temperatures above or below any given point; also shows the exact time of every temperature change and how rapidly it takes place. Recording pen and bi-metallic element are built in hinged, removable door which is also front of instrument. Thus, by merely changing doors it is easy to interchange temperature ranges or to convert to the Operation-Time Recorder described below. Instrument is 8" tall, 5 3/8" wide and 4 1/8" deep. Charts are 4 1/8 inches in diameter.

● OPERATION-TIME RECORDER

This instrument has a door unit which is identical to the door of the Recording Thermometer shown above. It makes record of number, frequency and duration of electrical operations such as starting and stopping of motors, heaters, etc. Pen is moved by the energizing of an electro-magnet when contact is closed. Available for either parallel or series connection.

Ask your Jobber or Write for Bulletin 720

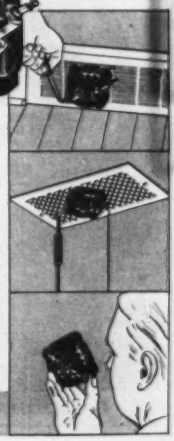
FLORITE
Air Velocity Meter

Available in two styles:

One with a scale of 0-1000 ft./min., and the other with a double scale of 0-3000 ft./min. and 0-35 miles per hour.

In principle, this unique instrument operates as an anemometer but provides instantaneous, direct readings of air velocity without timing, calculations or reference to charts. Readings are obtained by holding the instrument in the air stream so that air blows against its circular face, causing rotation of a multi-blade rotor mounted in instrument housing. The circular scale surrounding the rotor instantly turns to correct air velocity reading under an index pointer on scale window. This direct-reading anemometer is particularly useful for measuring air current velocities of air conditioning systems, grille velocities and air deliveries from registers and grilles; for balancing forced air heating systems, and for checking air distribution of all kinds of ventilating systems. Furnished with detachable handle (as illustrated), and leather case.

Ask your Jobber or Write for Leaflet 760



BACHARACH Industrial Instrument Co. 7000 BENNETT STREET · PITTSBURGH 8, PA.

RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 211. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

Aluminum Reduction

HPAC 101—A new booklet issued by the Reynolds Metals Co., 2500 S. 3rd St., Louisville, Ky., describes the company's Jones Mills, Ark., plant, which produces aluminum pig by the electrolytic reduction process.

Blower Type Unit Heaters

HPAC 102—The blower type unit heaters of C. A. Dunham Co., 400 W. Madison St., Chicago 6, designed for large area heating in factories, warehouses, etc., are described in bulletin 2301 issued by the company. Five types of mountings (floor, wall, ceiling, inverted and platform) are illustrated, and accessories such as mixing dampers, bypass dampers, and filter sections are shown. Also given are basic sizes of ten different assembly arrangements, shipping weights, typical specifications and conversion factors.

Blower Wheels

HPAC 103—Morrison Products, Inc., East 168th St. and Waterloo Rd., Cleveland 10, has issued bulletin 503 describing its blower wheels which are furnished together with shop drawings and templates, so that manufacturers may construct their own blower assemblies. Drawings of suggested assemblies are included and the company's blower parts are described.

Creep Stress Data on Tubing Steels

HPAC 104—Data card TDC 102, published by The Babcock & Wilcox Tube Co., Beaver Falls, Pa., gives creep stress data for rates of 1 percent elongation in 10,000 and 100,000 hr at temperatures of 800 to 1500 F for 16 carbon, intermediate alloy and stainless steels.

Dampers and Shutters

HPAC 105—Dampers and shutters for heating, air conditioning, ventilating and industrial applications are described in a brochure now available from the Minneapolis-Honeywell Regulator Co., Merchandising Div., Minneapolis 8. The booklet also describes the company's motor operating units for positioning dampers in response to temperature or pressure controllers.

Design Data for Multi-Room Air Conditioning System

HPAC 106—Complete technical data for laying out the "Custom-Air" year round air conditioning system for offices, hospitals, hotels and other multi-room structures

Only 7 lbs. pressure provides FINE, UNIFORM BREAK-UP AND DISTRIBUTION OF FLUID

with Binks ROTOJET clog-proof spray nozzles

Absence of internal vanes and obstructions permits maximum spraying efficiency at extremely low pressures with Binks' Rotojet Spray Nozzles. Designed on the off-center inlet, whirl chamber principle for greatest spraying effectiveness. Sizes up to ¾" pipe connection are of two-piece construction, precision-machined from finest quality brass bar stock, stainless steel or any special alloy that is machinable from bar stock. Sizes from 1" to 2½" have strong cast one-piece bodies. Wide capacity range.

Send today for technical bulletin describing Binks ROTOJET Nozzles

Bulletins give full information on sizes and capacities of the following Binks Rotojet Nozzles:
Bulletin Numbers:
10. Small and Medium Capacity Nozzles
11. Nozzles for Brine Spray Operation
12. Large Capacity Nozzles
13. Nozzles for Spray Ponds
14. Nozzles for Metal Cleaning Operations.

Please state how nozzles will be used, giving installation capacity.

THERE'S A BINKS SPRAY NOZZLE FOR EVERY SPRAY JOB

Binks MANUFACTURING COMPANY

REPRESENTATIVES IN ALL PRINCIPAL CITIES ■ 3118-38 CARROLL AVE., CHICAGO 12, ILLINOIS

This 'Snake' was charmed by WHITLOCK

At Whitlock, we know how to make pipes do tricks. Take this compound bend, for example. It's fabricated of 5" O.D. x 3.156" I.D. seamless monel pipe with a 3/32" silver lining . . . bent to 189° at one end, to 90° at the other end, and offset 0° 59' for draining. Tolerances are only ± 1/32" on all main dimensions. Here are the production operations in the sequence we followed:

(1) Test monel pipe hydrostatically to 6300 psi.
(2) Upset monel pipe ends to 7 ¼" diameter for a distance of 5 3/16".
(3) Silver line straight upset pipe to a minimum thickness of 3/32".
(4) Cold bend silver-lined pipe to details given and to tolerances specified (hot bending impossible because of lining).
(5) Thread pipe ends.
(6) Test bends hydrostatically to 6300 psi, using special test flanges to avoid injury to silver lining.
(7) Assemble special 15 ½" diameter x 3" thick forged steel flanges.

This is a typical illustration of Whitlock process equipment. If you could visit our plant, you would find heat exchangers, pressure vessels, pipe bends, coolers, condensers, vacuum chambers . . . in fact the widest range of work — all being constructed to rigid specifications to meet exacting customer or code requirements.

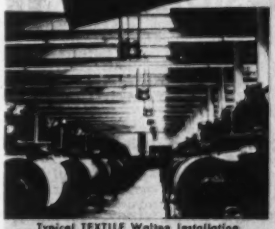
Whether your needs are standard or special, whether you require ferrous or non-ferrous materials, Whitlock facilities and techniques are ready to serve you. Write today for recommendations. THE WHITLOCK MANUFACTURING CO., 44 South St., Hartford 10, Conn.

WHITLOCK HEATERS

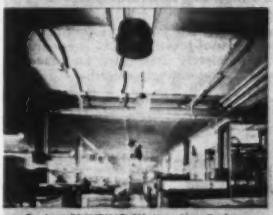
DESIGNS and BUILDS Bends • Coils • Condensers • Coolers Heat Exchangers • Heaters • Piping • Pressure Vessels • Receivers • Reboilers

When you need HUMIDITY specify- Walton

SPECIALISTS IN INDUSTRIAL, COMMERCIAL AND RESIDENTIAL CONTROLLED HUMIDIFICATION



Typical TEXTILE Walton Installation



Typical PRINTING Walton Installation

Typical TOBACCO Walton Installation

-because

you can satisfy any humidification requirement with modern Walton equipment. All are easily installed, use a minimum of water and electrical current. Thousands of varied installations for industries which must maintain controlled humidity conditions have proven Walton to be the standard for efficient performance and trouble-free operation. Check on the Walton System, now!

Send for complete NEW CATALOG FILE including—
"Industrial Humidification"
"Humidification for Textiles"
"Humidification for Knitting"
"Humidification for Graphic Arts"
"Humidification for Hospitals"
"Humidification for Home and Office"

Please address inquiries to DEPT 121

WALTON LABORATORIES • INC

Lo-BLAST Economite Gas Conversion Burner

LO-BLAST
POWER-TYPE GAS CONVERSION BURNER

CAPACITIES 70,000 TO 20,000,000 BTU INPUT

Regardless of the size of the heating plant, Lo-BLAST Gas Burners deliver more heat per fuel dollar. In 19 years of actual operation, these power-type units have consistently cut fuel and service costs.

Because primary and secondary air is perfectly controlled from a blower source, the Lo-BLAST Burner is independent of variable natural draft. Hence it is particularly well suited for down-draft boilers. Combustion is completed in an incandescent firebox, with radiant heat applied to crown sheet as well as side walls.

Other features include soft, quiet flame . . . standard controls with positive acting pilot and blower safetys . . . sturdy, fool-proof design . . . easy to install because completely assembled and factory-tested on gas . . . competitively priced.

A Lo-BLAST dealership is profitable! Complete range of capacities and a nation-wide reputation for economy make this burner a strong seller. Write for information.

The standard Lo-BLAST Gas Conversion Burner

MID-CONTINENT
METAL PRODUCTS CO.
1960 N. Clybourn Ave., Chicago 14, Ill.

is contained in a new 36 page bulletin, DS-369, prepared by The Trane Co., La Crosse, Wis. This system features individual temperature control for each room or apartment, while humidity and ventilation air are controlled centrally for the entire building. Typical arrangements of equipment are shown, the room units are described, and selection factors are given in charts and tables.

Diaphragm Motor Valves

HPAC 107—Specification sheet 418-1, issued by Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Wayne and Windrim Aves., Philadelphia 44, covers the company's series 700SG air operated diaphragm motor valves for wide band proportional control. They are skirt-guided and have a maximum operating temperature of 450 F. Details are given on sizes, construction, body materials, etc. Flow characteristic charts are included.

Flooded Electric Equipment

HPAC 108—A new 19 page booklet, *Reconditioning Flooded Electric Equipment*, has been issued by General Electric Co., Schenectady, N. Y. The general instructions are followed by separate sections on such equipment as steam turbine generators, d-c generators and exciters, transformers, meters, air switches, induction voltage regulators, high voltage bushings, lightning arresters, etc. Equipment is classified with regard to degree of damage, and different methods for reconditioning are suggested to fit specific cases. Detailed directions are given for disassembly, reassembly, and cleaning.

Flow Ratio Control Systems

HPAC 109—The special features of its automatic flow ratio control systems are described in catalog 53, recently issued by Fischer & Porter Co., 4600 County Line Rd., Hatboro, Pa. The principle of operation is described and a list of typical applications is given. The systems are designed for proportioning the flow of gases, liquids or slurries in two or more lines. If desired, they can be tied in with machine speeds, positive displacement meters, metering pumps or dry feeders.

Forced Draft Fans

HPAC 110—The Prat-Daniel Corp. is offering a new eight page illustrated bulletin, No. 300, describing the design features of its new forced draft fans which, on double wheel models, employ a split wheel design with a wide space, instead of a disc, between wheels. The split wheel provides four way diffusion. Various types of fan wheels and housing are shown. The booklet is available from The Thermix Corp., Greenwich, Conn.

Full Hardening Alloy Steel Tubing

HPAC 111—Problems involving the use of medium carbon grades (full hardening) of alloy tubing steels are discussed in a new four page bulletin, TDC 141, published by The Babcock & Wilcox Tube Co., Beaver Falls, Pa. Condensed data is given on microstructure, critical points, effect of alloy elements, forging, machining, welding, and thermal treatment for 14 alloy steels used in the production of tubular parts.

For DEFENSE *AGAINST CORROSION*

. . . use

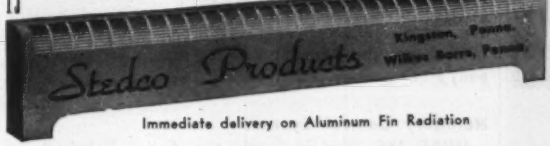
STEDCO FIN-TYPE RADIATION

. . . with Aluminum Fins

A NON-CORROSIVE HEATING ELEMENT

STEDCO fins are attached to the tubing in an inter-locking sleeve fashion and completely encase the center tubing. This makes a non-corrosive heating element plus giving a double contact surface area between fin and center tubing resulting in longer life and outstanding high heat capacity. One lineal foot of Stedco radiation with aluminum fins will give 1930 B.T.U. or 8 sq. ft. of E.D.R. per hour. Stedco radiation is also manufactured with steel fins.

Manufacturers of STEDCO *Compact Convectors*



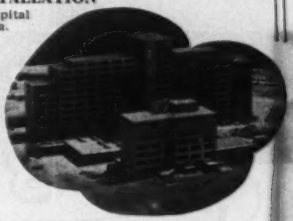
Immediate delivery on Aluminum Fin Radiation

HIGH HEATING CAPACITY

For Industrial, Commercial and Institutional installations where top performance is demanded!

A STEDCO INSTALLATION

U. S. Veteran's Hospital
Wilkes-Barre, Pa.



Stedco radiation was the choice for this hospital where economical, dependable heating is a prime requisite. Stedco met and passed the rigid specifications and requirements.

BETTER BUILT UNITED

This 7100 G.P.M. United tower serves the air conditioning system of a large Midwest hotel. It is deck filled, sheathed with cement-asbestos board and equipped with low pressure sprinkler distribution.

COOLING TOWERS

For All Refrigeration and Air Conditioning Requirements

- Individually designed mechanical draft towers of any required capacity for the larger installations.
- Standardized, prefabricated "package" type units of 5 to 30 tons refrigeration for the smaller jobs.

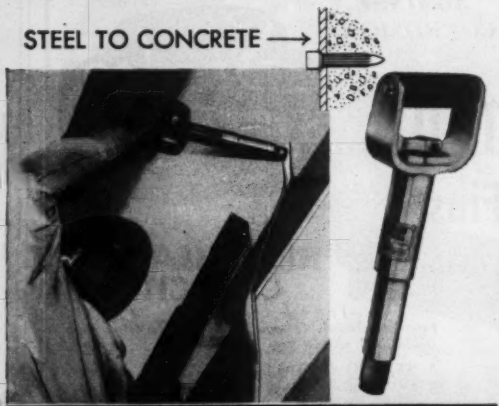
Complete details of design and construction in Bulletin No. 50, showing typical United installations in all fields . . . Power, oil, gas and refrigeration. Write for it today.

UNITED COOLING TOWER COMPANY

Porter Bldg. — *Authorized Representatives in Principal Cities* — *Kansas City 2, Missouri*

Set Studs into Steel or Concrete in seconds

STEEL TO CONCRETE →



with the

VELOCITY-POWER DRIVER

Better 3 Ways!

1. IT'S SIMPLE

One-handed operation. Load—position—fire. Stud imbedded—job done. Two basic parts—barrel and firing unit—easy to service. Integral cartridge bans matching and fitting—ready to use.

2. IT'S VERSATILE

Drives studs easily into steel or concrete. Interchangeable barrels permit driving of either ¼ or ⅜-in. studs from same firing unit. Wide range of studs available—solid head, internal or external threaded types.

3. IT'S SAFE

Center-fire cartridges plus spring-loaded safety arm that must be rotated 180 degress and held before stud can be fired makes accidental discharge impossible. Barrel design and long bearing area of piston avoids ricochet, flash, recoil. Cartridge assemblies assure right load for the job. Write for Bulletin No. TA-17.

DEALERS WANTED—Big, profitable sales opportunity in a broad market with this time, labor and money saving tool for maintenance, repair and construction work. Cartridge-studs bring repeat business. Act now!

VELOCITY POWER TOOL COMPANY

7505 Thomas Boulevard
Pittsburgh 8, Pa.

Glass Insulation for Piping and Process Equipment

HPAC 112—The Pittsburgh Corning Corp., 307 4th Ave., Pittsburgh 22, is offering a new 24 page booklet describing "Foamglas," its cellular glass insulation for piping and process equipment. Included are data for cold, intermediate, and hot applications, and details for insulating tanks, ducts, removable covers and tank heads, etc. Tables show sizes and shapes available and give recommended shapes and thicknesses.

Hermetic Centrifugal Refrigeration Unit

HPAC 113—Bulletin DS-399, issued by The Trane Co., La Crosse, Wis., describes the company's new "Centravac" water chiller, a hermetic centrifugal refrigeration unit with internal capacity control. Capacities range from 45 to 200 tons. Complete selection data, mechanical specifications and roughing in dimensions are given. In addition, the unit's cycle of operation and its purge and control systems are described.

Hot Water Sanitizing Unit

HPAC 114—The Heating Div., A. O. Smith Corp., has prepared a bulletin, No. HDH-1915, on its "Burkay 180" hot water sanitizing unit for use in small restaurants. It illustrates the matching use of the unit with the company's "Permaglas" water heater.

Humidity Control System

HPAC 115—Surface Combustion Corp., Toledo 1, is distributing a reprint of an article which describes an installation of the company's "Kathabar" absorption type humidity control system as it is used at the no. 1 Toledo plant of Doehler-Jarvis Corp.

Industrial Air Fans

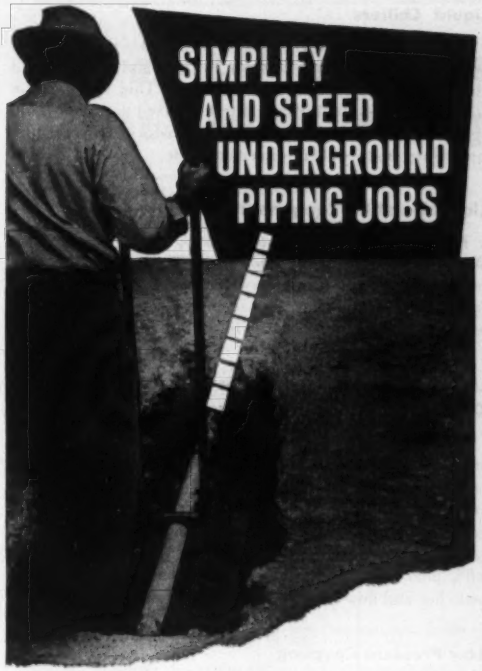
HPAC 116—The industrial air fans of The Harvey P. Bertram Co., Cincinnati 3, are described in a new 20 page booklet issued by the company. The parts of the fan are described (motors, propellers, orifice rings, etc.), and there are capacity charts for the various size fans. Dimensions and other data are given for the company's roof ventilators, and a friction and duct sizing chart for round and rectangular ducts is included.

Industrial and Institutional Incinerators

HPAC 117—A new 16 page catalog covering its incinerator line has been prepared by the Plibrico Jointless Firebrick Co., 1800 Kingsbury St., Chicago 14. The company's rubbish incinerator (in four sizes rated at 500 to 3500 lb per hr) is described, as is the portable incinerator. Also discussed are incinerators for wood refuse, and other special applications.

Insulating Cement

HPAC 118—A new folder issued by Baldwin-Hill Co., 500 Breunig Ave., Trenton 2, N. J., gives data on the composition, adhesion characteristics, shrinkage, set time, and thermal efficiency of its new "Powerhouse" cement, used for finishing and insulating.



. . . push pipe under streets, lawns, floors, walks with a

GREENLEE PIPE PUSHER

Cut costs, save time on underground pipe installations this fast, easy way.

With a GREENLEE Hydraulic Pipe Pusher *one man* can push pipe through the ground and under obstructions.

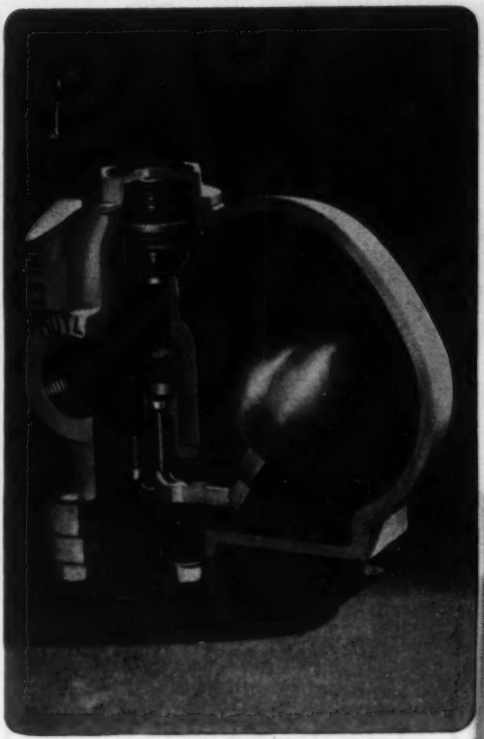
Saves the time, hard work, and inconvenience to all caused by the old methods of tearing up lawns, floors and pavement. Eliminates tedious digging, tunneling back-filling, tamping, re-paving, as just a short trench accommodates the pusher.

Save with the GREENLEE Pipe Pusher, which often pays for itself on the first few jobs. Learn all about this compact, portable, powerful pipe installing equipment.

Write for details today. Greenlee Tool Co., Division of Greenlee Bros. & Co., 2349 Twelfth St., Rockford, Ill.

TOOLS FOR CRAFTSMEN

GREENLEE



Why This Trap Provides Long Life Under the Severest Conditions

Barnes & Jones Float and Thermostatic Traps are designed and built to handle sudden and large condensate loads efficiently . . . *and dependably.* Trap responds instantly to change in condensate load, requires no change in temperature. Working parts are all easily accessible — and you need no special tools. B&J Float and Thermostatic Traps are made in five sizes and are built to handle loads all the way up to 5750 lbs. of water per hour.

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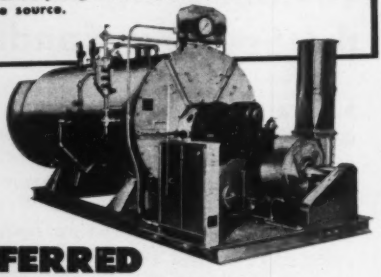
ONLY PREFERRED Offers Lowest Installation Costs

That's right! To install a Preferred Horizontal Rotary Oil Burner costs less than any other industrial oil burner. Exclusive and patented features cut time and labor needed for wiring, brickwork and piping. For example, all basic burner components are completely wired to the terminal junction box. Preferred has been able to lower installation costs because of their years of experience as a dealer, installer and distributor of oil burners. And they have put this practical experience to work for you.

Originally designed to meet the exacting requirements of the Preferred Unit Steam Generator, its fully automatic operation with residual fuels proved so successful that it has won wide acceptance for conversion applications.

It is available with associated Preferred products such as enclosed, pre-wired, union approved panels as well as pump and heater sets where applicable.

At Preferred you get all major job requirements from a single source.



PREFERRED Unit Steam Generator

The Preferred Unit Steam Generator is a custom-built boiler designed to maintain its guaranteed efficiency for a quarter of a century with a minimum of maintenance. It is the result of 28 years of combustion experience combined with the latest technical advances in pressure vessel design. That is why the Preferred unit offers the lowest installation cost, greatest economy and longest life of any steam generator.

Write for Burner Bulletin 175, Generator Bulletin 1000 and material cost estimates on your application. PR-201

PREFERRED UTILITIES MANUFACTURING CORPORATION
1860 BROADWAY, NEW YORK 23, N. Y.

Liquid Chillers

HPAC 119—Acme Industries, Inc., Jackson, Mich., has published bulletin no. 640 on its UX and UXR liquid chillers, for water, oil, alcohols, etc. This specification sheet covers liquid chilling units with fixed and removable type tube bundles. It gives heat transfer data, selection procedure, a schedule of dimensions, etc.

Liquid Handling Equipment

HPAC 120—Recently prepared by Bowser, Inc., Fort Wayne 2, Ind., a new folder, *1001 Ways*, illustrates and briefly describes the company's distilling, filtering, metering, pumping, storing, dispensing, degasifying and dehydrating equipment used in its liquid control systems.

Liquid Level Controls, Float Controls and Related Devices

HPAC 121—A new 20 page catalog issued by McDonnell & Miller, Inc., 3500 N. Spaulding Ave., Chicago 18, supplements the current condensed catalog issued by the company. It covers a number of products not described in that catalog, including special boiler water feeders, make-up water feeders for receivers, low water fuel cut-offs, float operated switches, small float valves, electrical switches and flow switches.

Low Pressure Coupling

HPAC 122—A new four page folder illustrating and describing its low pressure "Wedge-Lock" coupling has been issued by Naylor Pipe Co., 1230 E. 92nd St., Chicago 19. Designed for connecting lightweight pipe in ventilating and other low pressure applications, this one piece positive type coupling facilitates fast, simple installation, the manufacturer states. Included are complete specifications on pipe diameter sizes of from 8 to 30 in.

Manometers, Draft Gages and Other Instruments

HPAC 123—The Meriam Instrument Co., 10948 Madison Ave., Cleveland, O., has issued a new 44 page condensed catalog, C-12, illustrating and describing more than 100 of its instruments and accessories. U type, well type and multiple tube manometers, inclinometers, draft gages, liquid level gages, sight feed bubblers, and the complete line of accessories are covered. Many new manometer designs are included.

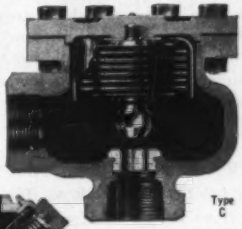
Metallizing

HPAC 124—The current issue (Vol. 5, No. 9) of the house organ of Metallizing Engineering Co., Inc., 38-14 30th St., Long Island City 1, New York, stresses possible reduction in the cost of maintenance and operating supplies through the metallization of worn equipment. Cited as an example is a Pennsylvania refinery which metallizes parts such as pump rods ranging in diameter from ¾ to 3½ in. and from 4 to 8 ft in length. Due to severe and varied operating conditions, wear occurs rapidly at the packing areas and formerly, this often necessitated replacement of the packing as well as the rods. Each worn rod is now metallized and re-metallized as wear occurs.

15 of 20 Engineers Prefer Nicholson Traps

To determine the best steam trap on which to standardize, a large processing firm recently asked their plant engineers for their preference. In 15 out of 20 plants the choice was Nicholson. The repeated adoption of Nicholson steam traps by plants currently in big "cost-reduction-through-modernization" programs is another indication of their advanced features. To learn why an increasing number of leading plants are standardizing on Nicholson thermostatic steam traps send for our catalog.

5 TYPES FOR EVERY APPLICATION, process, heat, power. Sizes ¼" to 2"; press. to 225 lbs.



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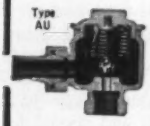

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Type C

BULLETIN 450

or see Sweet's

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- *Steam*
- *Cooling Water*
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- *Air Supply*
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Made of any metal, in all standard pipe sizes to 72" and in special fabricated types for round or rectangular ducts; pressure to 100 p.s.i. Flanged or threaded. Manual or automatic controls. Easy to operate and clean. Quick regulating and closing.

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W. S. ROCKWELL CO. 234 Eliot Street Fairfield, Conn.

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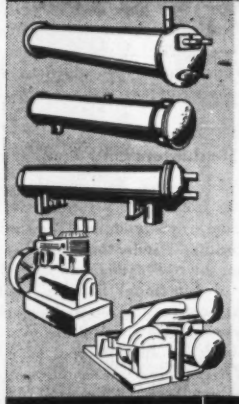

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CONDENSERS AND COOLERS
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Reconditioning and Overhauling Centrifugal and Reciprocating Pumps Centrifugal and Reciprocating Refrigerating Compressors Large Stock Tubes on Hand

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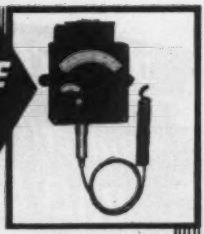
Fuel shortages or failures always pick the very worst time to occur SIEMON COMBI-MATIC Oil and Gas Burners will increase sales for you by eliminating many headaches for both you and your customers and assuring dependable, completely automatic, economical heat. Write today for complete information about this amazing new burner.

SIEMON & CO. 1819 HOLMES KANSAS CITY, MO.

NEW TYPE CI

ADJUSTABLE THERMOSTAT



The new Type CI Adjustable Indicating Thermostat is a precise temperature control for gas, liquid, and metal-to-metal applications, such as ovens, hot plate presses, water baths, incubators, proofing cabinets and cold cabinets. It is most useful on units where periodic checks of temperature are required, advisable, or will prove time-saving. The new Type CI is simply and ruggedly built, employing the highly sensitive response action of a solidly liquid-filled bulb and bellows assembly to a snap-acting switch and indicating pointer. The thermostat is adjustable over its entire range by a knurled thumbscrew on the front of the case.

SPECIFICATIONS:
Case 5½ x 5½ x 1¾"; Wt. 3 lbs. Standard ranges 50° – 350°F and 50° – 600°F, special ranges may be had between –120°F and +600°F. Standard differentials ½°F in circulating liquid, 2°F in air. Switch ratings 10 amp 125 V AC and 5 amp 250 V AC. Write for new bulletin No. 4816T which gives full details.

UNITED ELECTRIC CONTROLS COMPANY
87 School Street
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STANDARD & SPECIAL THERMOSTATS & PRESSURE SWITCHES

REZNOR

Hung from ceiling or mounted on floor

for all kinds of gas

As many Reznor units are operating in rural communities as in the metropolitan areas, because Reznor unit heaters use natural, manufactured and petroleum gases. No other heater is installed in as many industrial, commercial and domestic buildings.

With Reznor's new lift assembly, you install the Reznor heating machines with fewer men, in less time . . . far more easily.

Remember, Reznor has made gas space heaters and only space heaters since 1888. No wonder they lead all others. There's a Reznor district office near you . . . mail the coupon.

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31 UNION ST. · MERCER, PENNA.

Send me 20-page catalog in full color

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Address_____
City_____ Zone____ State_____

Motors

HPAC 125—A new bulletin has been issued describing various types of motors manufactured by the Delco Products Div., General Motors Corp., Dayton 1, Ohio. Included are single phase general purpose motors, single phase special motors (blower, oil burner, jet pump and cellar drainer motors), and a number of industrial motors.

Multi-Room Air Conditioning Systems

HPAC 126—A new 40 page handbook issued by The Trane Co., La Crosse, Wis., gives complete data on the company's one and two circuit "Unitrane" systems, requiring no ductwork, which are designed to provide individual room control of air conditioning in offices, hotels, and other multi-room buildings. Basis of the systems is the single circuit unit (for temperature control) and the two circuit unit (for temperature and humidity control).

Oxygen Recorder

HPAC 127—The "Magno-Therm" oxygen recorder of The Hays Corp., Michigan City, Ind., is described in a new bulletin, 51-829, prepared by the company. An introduction explaining how and why the instrument is used is followed by descriptions of how an analysis is made, of the recording section (its operation and special features), and of the operation of various gas sampling systems used with the instrument. Charts show the results obtained with the recorder in several installations.

Physics of Heat and Vapor Flow

HPAC 128—Heat and vapor flow, vapor permeability, condensation, conduction and density, convection, radiation and emissivity, reflection and absorption, and similar topics are discussed in the revised and expanded 56 page edition of *Simplified Physics of Vapor and Thermal Insulation*, by Alexander Schwartz, president, Infra Insulation Inc., 10 Murray St., New York. A chart of radiation and emissivity of materials has been added, and new installation and insulation techniques are described.

Pipe Hangers, Vibration Eliminators and Supports

HPAC 129—Catalog No. 51, issued by the Power Piping Div., Blaw-Knox Co., 1525 Pennsylvania Ave., Pittsburgh 12, covers the company's complete line of adjustable pipe hangers, vibration eliminators and supports. Information is given on the dimensions and special uses of the different types of functional hangers, and tables show the allowable movement for the internal swivel action featured in all these types. Also covered are overhead roller assemblies, standard and special types of vibration eliminators, standard rigid hanger assemblies, attachments to pipe (rings, clamps, etc.), pipe supports, brackets, and similar equipment. The special technical section covers specifications for pipe hangers and supports, describes and illustrates typical hanger problems, tabulates the weight of piping materials, and gives a chart showing the thermal expansion of pipe. Also outlined is the solution of a typical piping problem by the "Flex-Anal" chart method.

MASSACHUSETTS
PRESENTS

THE NEW MASSACHUSETTS AIR CONDITIONING UNITS

SEVEN SIZES . . . . . available, ranging from 1,000 to 14,000 C.F.M. Designed to combine cooling in summer, heating in winter.

Built in sections - Vertical or horizontal mounting. Various combinations and arrangements of discharge and by-pass damper.

Write for catalogs.

MASSACHUSETTS BLOWER DIVISION
The BISHOP & BABCOCK Mfg. Co.
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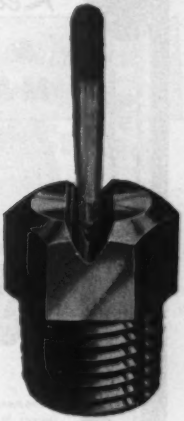
CUT SPRAYING COSTS



By accurately controlling the rate of flow, spray quality, angle and pattern, Delavan nozzles assure the most efficient, economical spraying job.

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Low Cost
Fast Work
Leakproof
Permanent

IT'S THIS EXCLUSIVE
RECESSED BRASS SEAT
that means
JOINTS THAT STAY TIGHT!

. . . when you use
JEFFERSON
SPECIALTY UNIONS

*Made from malleable iron with tensile strength of 55,000 lbs. per sq. in.—they won't fail.

*Rings are cut from a special brass tubing—they're not cast.

*Ring channels are *machined* rather than cast—no rocking of the seat.

*All Jefferson Unions are air tested for leakage before shipment.

These are just a few of the reasons why you should investigate our unions for your piping assemblies. We're sure you'll find them to be the solution to your piping problems.

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How to promote greater PER-MAN productivity!

Well-ventilated working environments contribute to faster, better defense production.

Western Rotary Turbine Ventilators provide constant, round-the-clock exhaust *without power*. A 2-mph breeze keeps your Western Rotary System in operation. Lifetime guaranteed bearings are both mounted on the same axis . . . always stay in alignment. Throat sizes 6" through 48", with the clean, low silhouette progressive industry demands.

Complete, up-to-the-minute information, sizes, capacities, and prices on all Western equipment upon request. In 1951 SWEETS and A. E. C.
AVAILABLE FROM YOUR FAVORITE WHOLESALER'S STOCK.

"ALWAYS ON THE JOB—NEVER ON THE PAYROLL"

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Really New!

A FLEXIBLE MANOMETER

Just Roll It Up and Tuck It Away

No more cumbersome 2', 3', or 4' manometers to cart around. This new flexible Dwyer Manometer will fit into your pocket or the corner of your service kit. This revolutionary instrument is fabricated of tough, vinyl plastic that will serve for years. The plastic scale is firmly supported between the tubes. Standard ranges from 8 in. to 6 ft. of water or mercury. It is highly accurate, easy to read and convenient. Nothing like it for field work. Write for complete information.

F. W. Dwyer Mfg. Co.

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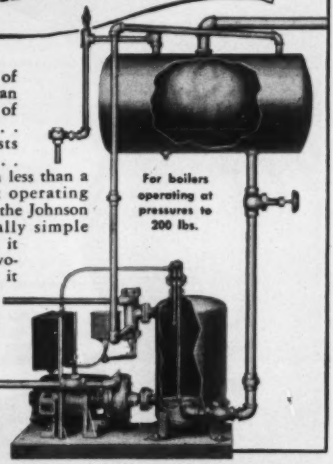
REVOLUTIONARY

THE JOHNSON *High Temperature* BOILER FEED SYSTEM



For boilers operating at pressures to 200 lbs.

Imagine a system of boiler feeding that can achieve fuel savings of 20% and more . . . slash pumping costs as much as 60% . . . save its own cost in less than a year! That's what operating records show about the Johnson System. It's basically simple and sound in *how* it works, yet truly revolutionary in what it accomplishes. Engineered and serviced by a nationwide organization.

Don't fail to write for the facts. Better yet, let us survey your needs without obligation.

The Johnson Corporation

806 Wood St., Three Rivers, Mich.

Quench Oil Cooling

HPAC 130—Systems which metalworking plants can use to increase quality and quantity production in heat treating are outlined in a new bulletin on the evaporative cooling of quench oils, D-350-2, published by The Trane Co., La Crosse, Wis. The bulletin discusses the advantages of cooling and circulation of quench oils (reduction in oil losses, etc.), and a number of evaporative cooler system control arrangements are diagrammed. The company's coolers, designed for use in a closed system, also are described.

Safety Relief Valves, Low Water Fuel Cutoffs, Boiler Water Feeders

HPAC 131—A new four page condensed catalog, C-44A, prepared by McDonnell & Miller, Inc., 3500 N. Spaulding Ave., Chicago 18, gives data and price listings for a number of the company's boiler water feeders, feeder cutoff combinations, and low water fuel cutoffs. The no. 33 series safety relief valves are described and some assemblies for greater output requirements are diagrammed.

Sheet Metal

HPAC 132—A. H. Lumm Co., 2512 Albion St., Toledo, has prepared a new bulletin describing its sheet metal plant, its equipment, and finished products. Typical ventilating installations made by the company are illustrated.

Spot Cooling Device

HPAC 133—Three models of "Belmont" vortex tubes (operation based on the Ranque-Hilsch effect) are catalogued in specification sheet V-2-551, issued by Thermo Instruments Co., 1173 El Camino Real, Belmont, Calif. In these devices, an internal vortex is used to separate a flow of compressed air or other gas into hot and cold fractions which can be used for calibrating instruments, cycle testing equipment, cooling thermocouples, etc. Operating characteristic curves are given and prices are listed.

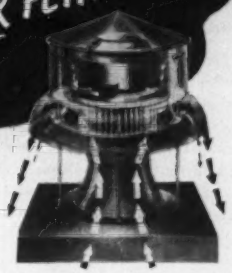
Stainless Steel

HPAC 134—A new 120 page cloth-bound volume published by Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, offers data on approximately 40 different types of the company's stainless steels. Material contained in previous handbooks has been rewritten for the new one and further information has been added. Each type of steel is covered from the standpoints of analyses, fabrication, heat treatment and special conditions of service. The first chapter contains a table which facilitates selection of the proper type of stainless steel for a given application. Heat and corrosion resistance and low temperature properties of the metals also are discussed.

Steam and Air Traps

HPAC 135—Armstrong Machine Works, Three Rivers, Mich., recently has issued a 12 page condensed catalog giving data and prices on its steam traps and air traps. Included are semi-steel and forged steel inverted bucket

THREE VITAL GALLAHER FEATURES



GALLAHER Air-Van POWER EXHAUSTERS

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Certified Ratings Impartial laboratory tests under the direction of a nationally recognized authority covering the entire unit. Capacities 150-11,000 CFM; Static Pressures to 1¾".

Scroll Effect An exclusive built-in Gallaher feature. Maximum efficiency beyond ¼" static pressure is not possible without it.

Safe Fume Handling Motor out of the airstream and a positive air **seal-off** around motor shaft prevents fume passage into motor housing while unit is in operation.

See your Gallaher Representative or write Dept. H. 4108 Dodge St., Omaha, Nebraska

The GALLAHER Company

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C.A. DUNHAM Company

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Hajoca Corporation takes pleasure in announcing it is now handling the complete Dunham line of top quality heating equipment including

Baseboard Radiation	Unit Heaters
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HEATING SYSTEMS AND EQUIPMENT DUNHAM

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A full line of sizes now available to meet all industrial requirements. Send for catalog.

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— such as water supply, brine circulation, booster service, white water and overflow, hot well, makeup water, etc., etc.

Capacities to 1,200 G.P.M.

Heads to 460 Ft.

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TYPE-AD Aurora Horizontally Split Case, Back-to-Back Impellers, Two Stage Centrifugal Pump. Particularly suited to clear water and low viscosity liquids not containing solids. Write for BULLETIN 106

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APCO TURBINE-TYPE PUMPS are unbeatable on low capacity, high head duties.

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QUIET YOUR AIR CONDITIONING
with INDUSTRIAL SOUND CONTROL
COOLING TOWER MUFFLERS

End ANNOYANCE • COMPLAINTS
THREATS OF LEGAL ACTION
DUE TO DISTURBING NOISE

ISC has solved the problem of silencing noisy air conditioning installations easily and economically. New or existing installations can be silenced by ISC engineering.

DON'T WAIT UNTIL THE COMPLAINTS COME IN
HAVE YOUR COOLING TOWER SILENCED NOW!

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Industrial Sound Control Inc.
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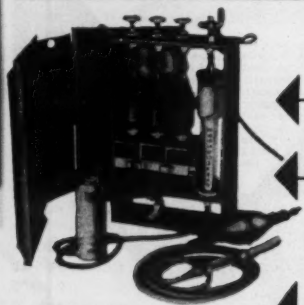
Analyze for CO, CO_2, O_2 with one instrument

HAYS ORSAT GAS ANALYZER



Complete—3 absorption units provide complete gas analysis for all the operating engineer's needs.

Rugged—built for continuous field use . . . strong, pressed steel construction.

Portable—contains everything you need to make a complete analysis . . . in one easy-to-carry case. Compact, yet all parts are easily accessible.

send for bulletin 49-668 for complete description of all styles.

The Hays Orsat Type Gas Analyzer is simple, fast, and employs the most reliable method known for obtaining accurate measurement. Available in one, two or three-unit styles (illustrated).

THE HAYS CORPORATION
MICHIGAN CITY 14, INDIANA
combustion and industrial instruments and control

traps, compound steam traps, ball float air traps, Y type strainers and internal check valves. Details are given on calculation of condensate loads and the selection of traps to handle them.

Steam Traps

HPAC 136—Catalog No. 751, published by W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa., covers the company's steam, air and gasoline traps. Illustrated and described are thermostatic steam traps, expansion steam traps, weight-operated and piston-operated traps and three types of steam, air and gas separators. Also given are capacity tables, installation diagrams, and data, charts and formulas for determining the proper size trap for specific applications.

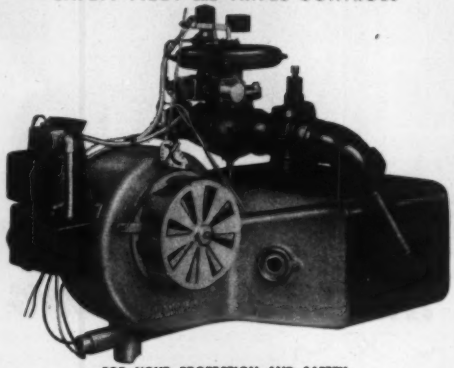
Steel Boilers

HPAC 137—A folder issued by Kewanee Boiler Corp., Kewanee, Ill., describes and illustrates four installations of the company's boilers, in two office buildings, a warehouse, and a bottling plant.

Textile Mill Air Conditioning

HPAC 138—Basic methods and principles of modern textile mill air conditioning are presented in a new manual released by Carrier Corp., Syracuse, New York. The booklet discusses the increased need for such air conditioning to protect the new high speed precision machinery

The Mettler "FAN-AIR" Gas Burner
LATEST MODEL FEATURES NEW AUTOMATIC SAFETY PILOT and TRIPLE CONTROLS



FOR YOUR PROTECTION AND SAFETY
Picture reveals some of the essential and desirable POINTS of FAN-AIR MECHANICAL DRAFT GAS BURNERS. Not just a burner but a COMPLETE and FULLY AUTOMATIC GAS BURNER SYSTEM, factory tested and ready for application when received. Furnished complete as pictured with simple, dependable automatic "On and Off" or modulating controls. Burner and Controls WITH SPARK IGNITION and FLAME SAFEGUARDS are scientifically coordinated to provide INSTANT FUEL SHUT-OFF on FLAME FAILURE—MEETING APPROVAL REQUIREMENTS. Why be satisfied with less—when all these tangible advantages are so readily available. Sizes 5 to 500 H.P.

Write for BULLETIN—
THE METTLER CO., INC.
(Note New Address)
4366 Worth Street, Zone 63, Los Angeles, Calif.

THERE IS ONLY ONE QUALITY OF RIC-WIL PREFABRICATED INSULATED PIPING . . .

THE *BEST* FOR THE JOB!

Specify RIC-WIL

Designed and manufactured to fit *all* your insulation, protection, and installation specifications exactly, Ric-wil Prefabricated Insulated Piping Systems provide an allover economy in fast installation, high operating efficiency, and low maintenance cost.

The same factors that have made Ric-wil "the Greatest Name in Insulated Piping" will give your system the BEST for the job!

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UNDERGROUND OR OVERHEAD

THE RIC-WIL COMPANY · CLEVELAND, O.

Fig. 3640 Close-Cupld Centrifugal

How Small Can An Air Conditioning Unit Be?

Small space is often a big problem in an air conditioning unit. Customers want their units out of sight and out of the way.

One way to save space is to use a Goulds Close-Cupld pump. These compact, highly efficient pumps use an amazingly small space—and do their job with great efficiency over long years of trouble-free service. It will pay you to investigate this line of modern, late design pumps. For larger jobs Goulds Double-Suction Centrifugals are equally dependable.

Call or write Pump Headquarters for complete information.

Goulds PUMPS INC. Seneca Falls New York

JOHNSON Direct Acting Solenoid Valve — for 150 lbs. Differential Pressure . . .

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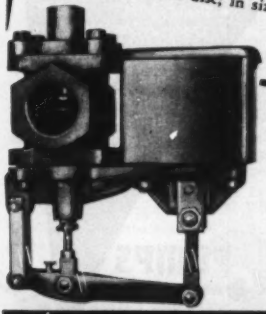
Write for Bulletin "Y"



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and the synthetic fibers now being used. The psychrometric chart is used to explain the functioning of the central station, the atomizer, and combination systems. Also covered are applications of air washers, refrigeration, and other equipment in producing the desired conditions, and of heat diffusers and fans in dyehouse ventilation.

Three Way Diaphragm Motor Valves

HPAC 139—A new four page specification sheet, no. 416-1, prepared by Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Station 40, Wayne and Windrim Aves., Philadelphia 44, gives technical data on materials, body pressure ratings, maximum differential pressure or drop, and flow lift characteristics of the company's three way diaphragm motor control valves in the "deluxe" and medium priced models. Mixing and diverting services are described as well as the types of discs and modes of control used for these services.

Tubing

HPAC 140—A new edition of its catalog has been issued by Nikoh Tube Co., 5000 S. Whipple St., Chicago 32. A description of the company's plant and organization is followed by a listing of the defense and regular industrial applications of its welded steel tubing, cold formed welded steel tubing, and electric resistance welded steel tubing. Tables summarize data on hardness conversion, round tubes, tolerance, square tubing, rectangular tubing, etc.

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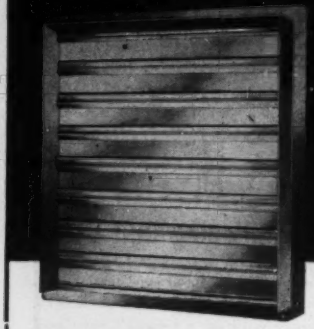

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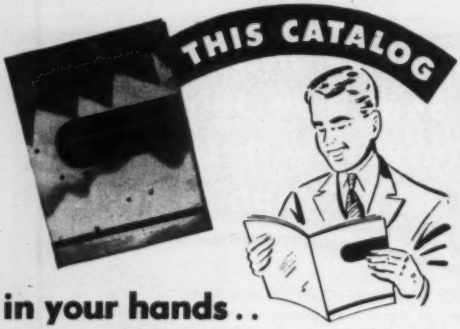

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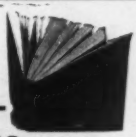

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Turbo-Ventilation

HPAC 141—The rotary turbine ventilators of Western Engineering & Manufacturing Co., 1726 E. Washington Blvd., Los Angeles 21, are featured in bulletin No. 50, recently issued by the company. Ratings and specifications are tabulated for these ventilators and for the company's curb mounted fan, booster fan, roof exhauster and "Airout." Information is given on how to specify the size and number of ventilators required, and there is a table of recommended air changes in minutes for various types of buildings. A list price sheet is included.

Unit Heaters

HPAC 142—Recently issued by C. A. Dunham Co., 400 W. Madison St., Chicago 6, is a 12 page bulletin, no. 1301, on propeller fan unit heaters. Design and construction features of both horizontal and vertical discharge heaters are given. Tables list basic steam and hot water capacities, conversion factors for steam and hot water, dimensions, decibel ratings, etc.

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HPAC 143—A new eight page catalog offered by Ingersoll-Rand Co., 11 Broadway, New York 4, describes the company's class APH-APK line of vertical turbine type pumps, applicable to bulk liquid transfer, cooling towers, dewatering and similar services where suction is taken from an open source. Construction features and dimensions are given, and typical applications are shown.

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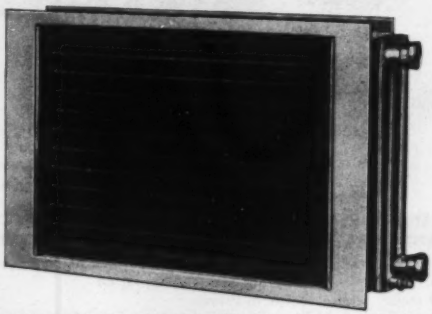

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INDEX TO ADVERTISERS

A-J Mfg. Co. ..... *
Acme Industries, Inc. 63
Aerofin Corp. 172
Air Conditioning Products Co. 260
Air Devices, Inc. 9
Air-Maze Corp. 160
Airtex Corporation ..... *
Airtherm Mfg. Co. 235
Alco Valve Co. 16
Aldrich Co. 154
Allen-Bradley Co. 188
Allis-Chalmers Mfg. Co. ..... 8, 37 & 165
American Air Filter Co. ..... *
American Blower Corp. 35
American Brass Corp., The 167
American Chain & Cable Co., The ..... *
American Radiator & Standard Sanitary Corp. 187
American Wheelabrator & Equip. Corp. . 239
Ames Iron Works 237
Anderson Co., V. D. 189
Anemostat Corp. of America 190
Armstrong Cork Co. 217
Armstrong Machine Works 191
Atlas Mfg. Co. 241
Auer Register Co. 263
Aurora Pump Co. 257
Autorad, Inc. 241

Babcock & Wilcox Co. 64
Bacharach Industrial Instrument Co. ... 245
Badger Manufacturing Co. 222
Baker Refrigeration Corp. ..... *
Barber-Colman Co. 151
Barnes & Jones, Inc. 251
Bayley Blower Co. 159
Bell & Gossett Co. 61
Binks Mfg. Co. 246
Bishop & Babcock Mfg. Co., The 255
Black & Decker Mfg. Co. ..... *
Breidert Co., G. C. 232
Brunner Mfg. Co. 209
Bryant Heater Co. ..... *
Buffalo Forge Co. ..... 10 & 11
Buffalo Pumps, Inc. ..... *
Bullard Co., The ..... *
Bundy Tubing Co. 221
Burnham Corporation ..... *
Bush Mfg. Co. 4
Byers Co., A. M. ..... *

Campbell Heating Co. 196
Carey Co., Phillip, The ..... 24 & 25
Carrier Corp. ..... *
Cash Co., A. W. 193
Century Electric Co. 13
Chase Brass & Copper Co. 198
Chicago Blower Corp. ..... *
Chicago Pump Co. ..... *
Clarage Fan Co. ..... Inside Back Cover
Cleaver-Brooks Co. 62
Cleveland Fuel Equipment Co. ..... *
C-O-Two Fire Equipment Co. 194
Combustion Engineering—
Superheater Inc. ..... *
Committee on Steel Pipe Research of American Iron & Steel Institute ..... *
Condenser Service & Engineering Co. ... 253
Connor Engrg. Co., W. B. ..... 45 & 155
Continental Air Filters, Inc. ..... *
Copeland Refrigeration Corp. ..... *
Correctair Div., Boyle-Midway, Inc. 51
Crane Co. 36
Crocker-Wheeler Div. Elliott Co. ..... *
Curtis Refrigerating Machine Co. ..... *
Cyclotherm Corp. ..... *

Davis Engineering Corp. ..... *
De Bothezat Fans Division American Machine & Metals, Inc. .. 215
De Laval Steam Turbine Co. 47
Delavan Mfg. Co. 255
Detroit Lubricator Company 31
Detroit Stoker Company ..... *
Dodge Mfg. Co. 17
Dole Refrigerating Co. ..... *
Dole Valve Co., The 44
Dollinger Corp. 201
Dravo Corporation 56
Dunham Co., C. A. 208
Durant Insulated Pipe Co. ..... *
Dwyer Mfg. Co., F. W. 256

Eagan Co., Inc., Walter H. 239
Economy Pumps, Inc. 204
Emerson Elec. Mfg. Co. ..... *

Fairbanks Co. 242
Farr Co. 6
Fedders-Quigan Corp. ..... 28 & 29
Fisher Governor Co. 193
Fitzgibbons Boiler Co., Inc. 143
Fluid Systems ..... 32 & 33
Frick Co. 229
Fulton Sylphon Co. 15

G. & O. Mfg. Co., The 257
Gallaher Co. 257
General Controls Co. 169
General Electric Co. 157
Glasfloss Corp., The 203
Goulds Pumps, Inc. 259
Governair Corp. 230
Greenlee Tool Co. 251
Grinnell Co., Inc. ..... Inside Front Cover
Gustin-Bacon Mfg. Co. ..... *

Hajoca Corporation 257
Hamilton-Thomas Corp. 204
Handy & Harman ..... *
Hapman-Dutton Co. 236
Hastings Instrument Co., Inc. 227
Hayes Furnace & Mfg. Co., Inc. 174
Hays Corp. 258
Hendrick Mfg. Co. ..... *
Henry Valve Co. ..... *
Hoffman Specialty Co. 185
Holsclaw Bros., Inc. ..... *
Howell Electric Motors Co. ..... *
Hussey & Co., C. G. ..... *

Ilg Electric Ventilating Co. ..... *
Illinois Engineering Co. 175
Illinois Testing Laboratories, Inc. ..... *
Independent Register Co. 224
Industrial Sound Control Inc. 258
Infra Insulation, Inc. 213
Ingersoll-Rand 55
Iron Fireman Mfg. Co. ..... *

Jackson & Church Co. ..... *
Jefferson Union Co., Inc. 255
Jenkins Bros. 210
Jenn Air Products Co. 261
Johns-Manville ..... 180 & 243
Johnson Co., S. T. 42
Johnson Corp. ..... 256 & 259
Johnson Service Co. ..... Outside Back Cover
Joy Mfg. Co. 182

Kaylo Div., Owens-Illinois Glass Co. .. *
Keasbey & Mattison Co. ..... *
Kennard Corp. ..... *
Kennedy Valve Mfg. Co., The ..... *
Kewanee Boiler Corp. 152
Key Co. 259
Klipfel Valves, Inc. 204
Kritzer Radiant Coils, Inc. 243

Ladish Co. 165
Lee Corporation, The 234
Lefax 263
Leslie Co. 184
Lincoln Electric Co., The ..... *
Lunkenheimer Co., The ..... *
Lycoming Spencer Div., Avco Mfg. Corp. 41

Marley Co., The 52
Marlo Coil Co. ..... *
Marsh Heating Equipment Co. 183
McCord Corp. 238
McDonnell & Miller, Inc. 53
McGraw-Hill Book Co., Inc. 262
McQuay, Inc. 42
Mercoid Corp., The 261
Mettler Co., Inc., The 258
Mid-Continent Metal Products Co. 248
Midwest Piping & Supply Co. ..... *
Minerallac Electric Co. ..... *
Minneapolis-Honeywell Regulator Co. .. *
Modine Mfg. Co. ..... 18 & 19
Muckle Mfg. Co. 263
Mueller Brass Co. ..... *
Mueller Furnace Co., L. J. 216
Multi-Vent Div., Pyle National Co. 158
Mundet Cork Co. 156
Murray Mfg. Co., D. J. 223
Mystik Adhesive Products 185

Nash Engineering Co. 72
National Heater Co. 245
National Radiator Co., The ..... *
National Tube Co. ..... *
Nelson, Herman Div. of American Air Filter Co., Inc. 195
Nesbitt, Inc., J. J. 68
New York Blower Co., The 178
Niagara Blower Co. ..... *
Nicholson & Co., W. H. 253

Ohio Brass Co. 170
Ohio Injector Co. 34
Olson & Company, Arthur A. 150
Orr & Sembower, Inc. 219
OverHead Heaters, Inc. 176
Owens-Corning Fiberglas Corp. 177

Peerless Elec. Co. ..... *
Peerless Pump Div., Food Machinery & Chemical Corp. ..... *
Penn Electric Switch Co. 22
Perfex Corp. 231
Penn Ventilating Co. ..... *
Pittsburgh-Corning Corp. ..... *
Porter & Co., H. W. 233
Powers Regulator Co., The 49
Prat-Daniel Corp. ..... *
Preferred Utilities Mfg. Co. 252
Pritchard Co., J. F. 7
Propellair, Inc. ..... *

R P & C Division American Chain & Cable Co., The 181
Ramset Fasteners, Inc. ..... *
Register & Grille Mfg. Co. 261
Reinhard Brothers Co. ..... *
Rempe Co. 262
Republic Steel Corp. ..... *
Research Products Corp. ..... *
Revere Copper & Brass, Inc. 71
Reznor Manufacturing Co. 254
Rhode Island Fittings Co. ..... *
Rhodes, Inc., M. H. ..... *
Ric-wiL Co., The 259
Ridge Tool Co. 220
Rockwell Co., W. S. 253
Roth Co., Roy E. 260

SKF Industries, Inc. 163
Sarco Co., Inc. 12
Sarcotherm Controls, Inc. ..... *
Schaub Engineering Co., Fred H. ..... *
Sellers Engineering Co. 50
Servel, Inc. ..... *
Siemon & Co. 253
Skidmore Pumps 237
Smith Co., Inc., H. B., The ..... *
Spang-Chalfant Div. of The National Supply Co. 46
Spence Engineering Co., Inc. 164
Spencer Heater ..... *
Sporlan Valve Co. ..... *
Spraying Systems Co. 260
Standard Stamping & Perforating Co. .. 205
Stedco Products 249
Stephens-Adamson Mfg. Co. 197
Sterling, Inc. 240
Sterling Electric Motors ..... *
Stic-Klip Mfg. Co. ..... *
Sturtevant Co., B. F. Div. of Westinghouse Elec. 162
Superior Combustion Industries, Inc. ... 171
Surface Combustion Corp. 202
Swartwout Co. ..... *

Taco Heaters, Inc. ..... 38 & 39
Taylor Forge & Pipe Works 59
Taylor Instrument Cos. ..... *
Thrush & Co., H. A. 43
Titus Mfg. Corp. 57
Titusville Iron Works Co., The, Div. of Struthers Wells Corp. 226
Trane Co., The ..... 20 & 21
Tri-Clover Machine Co. 244
Tube Turns, Inc. ..... 199 & 200
Tuttle & Bailey, Inc. 54
Typhoon Air Conditioning Co., Inc. .. *

Union Asbestos & Rubber Co. 153
Unistrut Products Corp. ..... *
United Cooling Tower Co. 249
United Electric Controls Co. 254
United States Air Conditioning Co. 3
United States Steel Co. ..... *
Utility Appliance Corp. 23

Velocity Power Tool Co. 250
Vulcan Radiator Co. 60

Wagner Electric Corp. 149
Waldron Corp., John ..... *
Walton Laboratories 247
Walworth Co. ..... 26 & 235
Ward Leonard Elec. Co. 218
Watson-Stillman Co. 40
Webster & Co., Warren 67
Webster Engineering Co., The 228
Weil Pump Co. ..... *
Welding Fittings Corp. ..... *
Western Engineering & Mfg. Co. 255
Wheatland Tube Co. 30
Wheeler Mfg. Co., C. H. 161
Wheo-Rodgers Electric Co. 179
Whitlock Mfg. Co. 247
Wiegand Co., Edwin L. 262
Will-Burt Company, The 168
Wilson & Co. ..... *
Wilson, Inc., Grant 148
Wing Mfg. Co., L. J. 225
Wolverine Tube Div. of Calumet & Hecla Consolidated Copper Co. 173
Worthington Pump & Machinery Corp. .. 147

Yarnall-Waring Co. 14
Yates-American Machine Co. 261
York Corp. ..... *
York-Shipley 58
Young Radiator Co. 27
Youngstown Sheet & Tube Co. 146

Zallea Bros. 48

Firms represented in this issue are identified by the folio of the page on which their advertising appears. Advertising which appears in other issues is marked with an asterisk.

* Upjohn

installs

CLARAGE HEAVY-DUTY FAN EQUIPMENT

Fine Pharmaceuticals!...the making of over 700 different kinds has started in this great plant of the Upjohn Company, 10 minutes south of Kalamazoo.

Here much of the manufacturing...***to maintain integrity of product***...is dependent upon air conditioning. 120 complete systems handling 2,800,000 c.f.m. are installed.

"A multimillion dollar project... Engineers and Builders, The Austin Company, Cleveland."

Upjohn has had more than a quarter-century of experience with Clarage Equipment. It well may be that this was the deciding factor in selecting Clarage ***HEAVY-DUTY*** Fans for ***every one*** of the air conditioning systems operating in this new Upjohn plant.

CLARAGE
—HEADQUARTERS for Air Handling and Conditioning Equipment

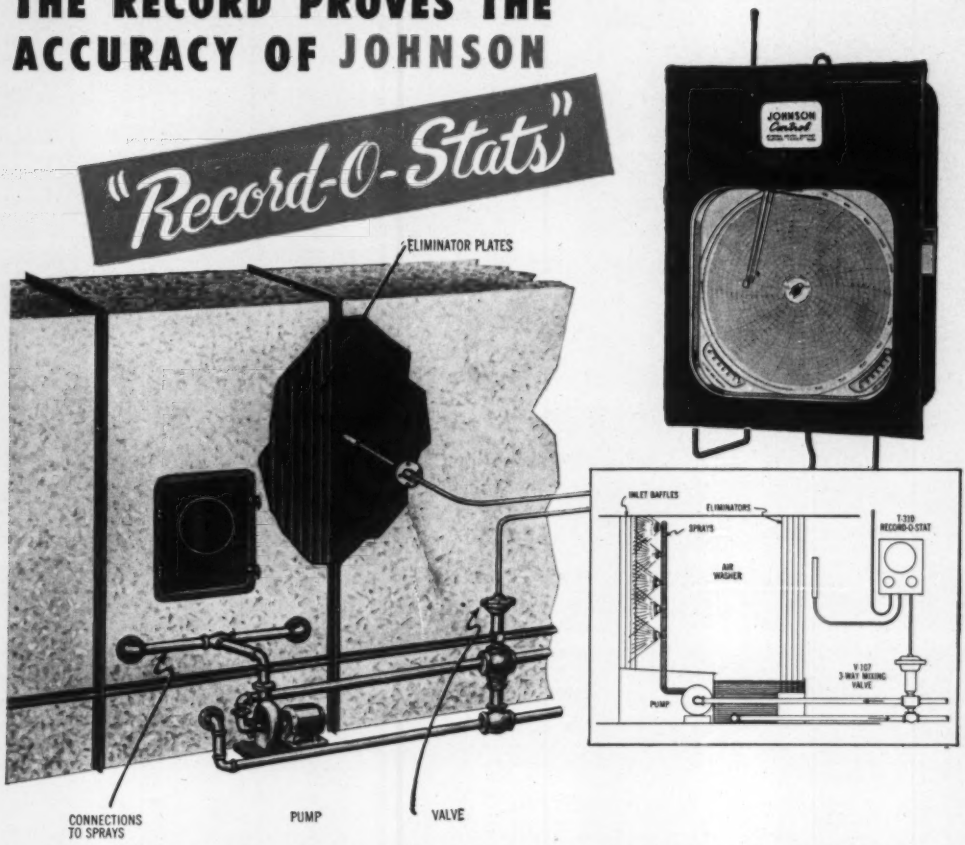
CLARAGE FAN COMPANY

KALAMAZOO, MICHIGAN

APPLICATION ENGINEERING OFFICES . . . . IN ALL PRINCIPAL CITIES

THE RECORD PROVES THE ACCURACY OF JOHNSON

"Record-O-Stats"



The application pictured above shows a Johnson "Record-O-Stat" maintaining a constant dew-point temperature of the air leaving the washer. And, a record of the temperature is always available for reference, which often is an important consideration where industrial processes depend upon space conditions. The Johnson three-way mixing valve, operated by the recorder-controller, insures a uniform temperature of the water which is delivered by the sprays.

Wherever temperatures must be controlled accurately and a record preserved, at the same time, the Johnson "Record-O-Stat" is the finest equipment of its kind. This recorder-controller records the temperatures measured by the bulb on a uniformly graduated chart. Standard charts are available in a variety of temperature ranges and may be had, on special order, in any desired range. On special order, also, the "Record-O-Stat" may be equipped with chart drive and charts to record temperatures for an entire week of operation.

All Johnson equipment is engineered for the most exacting results. When Johnson valves for steam, air and other gasses are halfway open, there's plenty of "throttling range" left for the final 50 per cent of valve stem travel. True modulation over the entire range of valve stem travel!

The exclusive Johnson features make the "Record-O-Stat" widely adaptable and efficient in imparting proportional (gradual) action to the pneumatic valves or damper operators which it controls.

ASK FOR BULLETIN T-310 which describes "automatic" reset and other features obtainable in Johnson "Record-O-Stats". JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

JOHNSON *Automatic Temperature and Air Conditioning* **CONTROL**

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885